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UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA, WESTERN DIVISION

CORY SPENCER, an individual; DIANA MILENA REED, an individual; and COASTAL PROTECTION RANGERS, INC., a California non-profit public benefit corporation, Plaintiffs,	CASE NO. 2:16-cv-02129-SJO (RAOx) **DECLARATION OF PHILIP KING IN SUPPORT OF PLAINTIFFS' OPPOSITION TO DEFENDANTS CITY OF PALOS VERDES ESTATES AND CHIEF OF POLICE JEFF KEPLEY'S MOTION TO STRIKE THE DECLARATION OF PHILIP KING** Judge: Hon. S. James Otero

v. LUNADA BAY BOYS; THE INDIVIDUAL MEMBERS OF THE LUNADA BAY BOYS, including but not limited to SANG LEE, BRANT BLAKEMAN, ALAN JOHNSTON AKA JALIAN JOHNSTON, MICHAEL RAE PAPAYANS, ANGELO FERRARA, FRANK FERRARA, CHARLIE FERRARA, and N. F.; CITY OF PALOS VERDES ESTATES; CHIEF OF POLICE JEFF KEPLEY, in his representative capacity; and DOES 1-10, Defendants.	Date: February 21, 2017 Time: 10:00 a.m. Crtrm.: 10C

I, Philip King, declare as follows:

1. I am a professor of economics at San Francisco State University (SFSU) and was recently retained in December, 2016 as an expert in this matter on behalf of Plaintiffs Cory Spencer, Diana Milena Reed, and the Coastal Protection Rangers, Inc.

2. I have over twenty years of experience in the field of economic valuation of beach/coastal recreation. As shown on my *curriculum vitae* (attached to my previously-filed declaration), my work has been published in scholarly journals and cited numerous times.

3. Economists have developed multiple standard techniques for valuing recreation. One widely used technique is referred to as the travel cost ("TC") method, which has been applied not only to beaches but many other forms of recreation. A TC study estimates the willingness to pay and consumer's surplus generated from a beach (or other recreational) trip.

4. I chose not to employ the TC method in my analysis for two main reasons. First, the TC method requires a detailed study of travel patterns to a particular site, usually involving a survey instrument and some sort of periodic count to estimate attendance. However, in the case of Lunada Bay, because travel patterns are influenced heavily by non-economic forces (in particular, localism) constraining surfing and other recreational activities at that site, it would be very difficult to collect the necessary data for an accurate and reliable estimate of recreational value based on TC analysis. Secondly, the TC method is time consuming and expensive to execute, and there was not sufficient time to conduct a valuation employing TC method.

5. Where (as was the case here) a TC study is not feasible, economists typically use a technique known as "benefits transfer" (BT) which looks at the recreational value of one or more similar sites, typically in recreational value per day. This technique has been used by many state, local and federal agencies to value natural resources. In particular, the National Oceanographic and Atmospheric Administration (NOAA) uses BT techniques to estimate the recreational value of a site where limited data is available. (See, for example, NOAA publication "Economics for Coastal Managers," 2009, p.10, attached hereto as **Exhibit A**).

6. The first step in BT analysis is to identify suitable comparable sites. I was able to determine that Lunada Bay is a premier surf site. This determination was based upon conversations with many expert surfers, as well as a review of online resources I have determined to be reliable in my twenty years of experience, including Surfline.com and Wannasurf.com.

7. I determined that the closest and most relevant comparable beaches to Lunada Bay are Trestles beach and Mavericks beach. Both Trestles and Mavericks are highly valued surf spots in California with reputations among expert surfers comparable to Lunada Bay, similar ratings

and reviews to Lunada Bay, and located in the same general region as Lunada Bay.

8. Having identified multiple appropriate comparable sites, I then located reliable TC studies of the comparable sites from reputable sources, conducted by other Economists whose work is respected in the field.

9. Dr. Makena Coffman and Dr. Kimberly Burnett, both from the University of Hawaii, conducted a travel cost study of Mavericks and estimated that the value of a day of surfing was $ 56.70 per day in 2009 dollars. (See Coffman and Burnett, 2009, attached hereto as **<u>Exhibit B</u>**). In 2016 dollars, this estimate would almost certainly be significantly higher given not only the increased cost of living but also higher disposable incomes of visitors.

10. Dr. Chad Nelson, the former Environmental Director and current CEO of Surfrider Foundation and a widely respected surf economist, conducted a similar study at Trestles beach and determined that a conservative estimate of the value of a day of surfing at Trestles was between $80 and $138 per day. Dr. Nelson's findings were published and made available at https://www.surfrider.org/coastal-blog/entry/the-economics-of-surfing.

11. Consequently, the estimate I used for the recreational value of surfing at Lunada Bay ($50 to $80 per day) is appropriate, based upon standard and widely accepted methodology, and, indeed, conservative.

12. As I gather additional information and conduct further analysis, I anticipate that my estimated recreational value of surfing at Lunada Bay will increase. Additional work I have done since submitting my prior declaration on December 28, 2016, including additional interviews of surfing experts, has further suggested that my initial estimates were very conservative.

13. My work in accurately assessing the value of beaches

necessarily involves estimating annual attendance at coastal sites. I have over twenty years of experience providing professional estimates of annual attendance at coastal sites. I have been involved in numerous projects funded by State, local and Federal agencies involving application of estimates of the number of visitors to a particular beach (where official estimates do not exist). A non-exhaustive list of illustrative samples I prepared is attached hereto as **Exhibit C**.

14. With regard to my methodology for estimating expected annual attendance at Lunada Bay under normal circumstances, I used a standard technique which allows one to estimate the total attendance at a beach (or other recreational site) in a given day by applying periodic counts throughout the day. This standard, widely accepted methodology is outlined in my paper, "Who's Counting: An Analysis of Beach Attendance Estimates and Methodologies in Southern California[1]" attached hereto as **Exhibit D**. This technique is also used in other widely cited papers, such as Banzhaf[2] and Deacon and Kolstad.[3] In essence, one determines attendance using periodic counts at different times during the day and then applies a probability distribution function using arrival and departure times to estimate total daily attendance.

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[1] "Who's Counting: An Analysis of Beach Attendance Estimates in Southern California," w. A. McGregor, *Ocean and Coastal Management*, March 2012, Pages 17–25.

[2] Banzhaf, S. H. 1996. Estimating Recreational Use Levels with Periodic Counts. Working Paper T-9602. Duke University. Triangle Economic Research.

[3] Deacon, R., and C. Kolstad. 2000. "Valuing Beach Recreation Lost In Environmental Accidents." *Journal of Water Resources Planning and Management* 126(6): 374-381. A true and correct copy of this paper is attached hereto as **Exhibit E**.

15. My application of this technique was somewhat simplified given the limited data, but is consistent with standard methods. Further, as I discuss in my Who's Counting paper, empirical observations of surfers indicate that they tend to surf in the morning, and then late in the afternoon. Since my analysis only assumes three "shifts" per day, it likely underestimates the total number of surfers.

16. I was able to locate an estimate of annual attendance at Trestles performed by Dr. Nelson, who determined that Trestles receives 330,000 surf day visits annually.

17. I considered material variances between Trestles and Lunada Bay, including the size of the break and related capacity constraints. Lunada Bay's break size and surf capacity is somewhat smaller relative to Trestles. As a result, my preliminary estimate reflects that Lunada Bay would receive fewer surf day visits annually than Trestles.

18. Because this analysis was preliminary in nature, the conclusion reflected in my December 28, 2016 declaration (i.e., 20-25 surfers in the water on the main point during good weekday conditions, 60-75 surfers per day on average, 20,000-25,000 surfers visiting annually) are very conservative. Information I have gathered since submitting my December 28, 2016 declaration suggests that my final estimated attendance at Lunada Bay under normal conditions based will, in fact, be substantially higher.

19. Since December 28, 2016, when I submitted my declaration in support of the class certification motion, I was able to speak with Steve Hawk, a former editor of *Surfer* magazine from 1990 to 1998, former editorial director of Surfline/Swell.com, and an executive editor of *Sierra* magazine. Mr. Hawk confirmed my assumption that Lunada Bay is a world class wave, and that it is under-utilized because visiting surfers are deterred by a group of local surfers. My discussion with Mr. Hawk leads me to

believe that my estimated quantification of daily and annual visitors to Lunada Bay is too low, as he believes that more than 75 surfers per day would visit Lunada Bay if it were not for localism. Further, he believes, as I suspected, that other visitors would be drawn simply to watch both the surf and surfers.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed in Davis, California on February 3, 2016.

Philip C. King

PHILIP KING

EXHIBIT A

SOCIAL SCIENCE TOOLS FOR COASTAL PROGRAMS

Introduction to Economics for Coastal Managers

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Social Science Tools for Coastal Programs

Introduction to Economics for Coastal Managers

About This Publication

Some of the most challenging decisions in coastal management stem from the relationship between people and the environment. The National Oceanic and Atmospheric Administration's Coastal Services Center provides technical assistance to coastal management professionals addressing complex human-based problems. "Introduction to Economics for Coastal Managers" is the third in a series of publications developed to bring information to this audience about the use of social science tools in their field of work. For additional information about social science tools and applications, please visit *www.csc.noaa.gov/cms/human_dimensions/focus_socialsci.html.*

About the NOAA Coastal Services Center

The Coastal Services Center, an office within the federal government's National Oceanic and Atmospheric Administration (NOAA), works with state and local programs devoted to the wise management of our nation's coastal resources. The NOAA Coastal Services Center provides these programs with tools, training, and expertise that might otherwise be unavailable. To learn more about the products and services available from this agency, visit *www.csc.noaa.gov.*

Table of Contents

Introduction

Managing coastal resources often means making hard decisions about the best way to use those resources—especially when there are competing demands.

For example, do you

- Maintain the green space or build more homes?
- Develop a new marina or keep the existing oyster beds?
- Construct a mall that would draw in new industry or preserve the wetland?

Although there is no simple way to answer these questions, economic methods can help coastal resource managers understand the trade-offs and make better-informed decisions about managing the resource.

This document provides a basic introduction to economic ideas and methods that can be applied to coastal resource management. These economic concepts are illustrated by several case studies. After reading this document, coastal resource managers should have a better understanding of the powerful economic methods at their disposal.

The Power of Economic Methods and Concepts

Economic tools can be used to maximize the usefulness of coastal resources and make the community as well off as it can be—socially, economically, and environmentally. When considering the best way to manage a resource, managers can use economic tools to express the values of alternatives in common terms (usually dollars) so that an "apples to apples" comparison can be made and the alternative that maximizes the benefit to the community will be chosen.

Economics can help people consider the trade-offs they face to achieve economic and environmental goals.

Applying Economics to Coastal Resources

To apply economics to the management of coastal resources, the cost, expertise, and type of economic information required to make resource decisions should be considered.

Cost and Expertise

The cost of conducting economic research and analysis can be considerable, but knowing the economic value of coastal resources can help ensure that you don't trade off things that are worth more—for things that are worth less. Because of the difficulty in placing a dollar value on many of the benefits provided by coastal resources, these benefits are often assigned a value of zero (King 1998), even though the resources provide considerable value to the community and the local ecosystem.

For example, part of the value of a coastal resource comes from the ecosystem services it provides, such as those services supplied by a maritime forest and salt marsh:

- Habitat and feeding grounds for commercial, recreational, and other fisheries
- Habitat for threatened species of birds
- Filtration and purification of runoff water
- Protection of buildings and other infrastructure from coastal storms, by absorbing energy and holding off floodwaters
- Enhancement of aesthetics (and, consequently, market value) of adjacent homes

If these services are assigned a value of zero, cutting down the forest and filling in the wetland to build a new business district might look economically advantageous. However, the development may actually have hidden costs to the community because the true value of the resources was not considered. For example, property damage from floods may increase, causing higher insurance premiums and lower house values in the area.

That being said, development may be the right choice in some cases. Only when the true value of a coastal resource is known can one make decisions that make the most long-term economic sense for the community—be it leaving the resource alone, developing it, or designing a partial development plan with fewer impacts.

> *Development tends to generate benefits that are easy to count and understand, while conservation tends to generate benefits that are harder to count and understand (Boyd, Sanchirico, and Shabman 2004).*

The cost of economic research and analysis depends on many factors, including

- Size of the area where the resources are located
- Number of people who use the resources
- Type of survey method
- Type of economic value involved

However, if a full economic assessment is too costly to consider, economic methods to manage coastal resources can still be used. For example, information from an existing economic study conducted by someone else can be applied to other situations that are similar. This method is called benefits transfer.

Expertise Required. Performing an economic assessment is a complex—and often controversial—process, so make sure someone who has a background in economics is involved. Even the methods that are seemingly straightforward require judgments based on economic theory.

When trying to estimate the more complicated types of economic value, it is especially important that you work with someone with proven experience with that type of valuation. Otherwise, the results may not be acceptable in certain contexts (such as damage assessments or regulations).

Economic Options

The term "economics" encompasses a broad spectrum of methods and concepts, so there are a lot of different ways to use economics to help manage coastal resources.

No single method will be appropriate for all situations, so one of the first things to consider is what type of economic option will provide the necessary information to manage the coastal resource most effectively.

For example,

- To show how the local economy would be impacted by resource management decisions, an economic profile, including information such as industries and the number of jobs, would be created. This profile would serve as an economic baseline to see whether a proposed management action, such as prohibiting fishing in some areas, would have positive or negative effects on the local economy.
- To understand the total economic value of a resource, one would estimate many different types of value and then add them together.
- To consider alternative management options, one might look at the economic benefits and costs associated with each option and choose the option that offers the best value—the greatest benefits at the least cost.

A complete economic analysis of water and related land resources can be accomplished by identifying problems and opportunities for the resource—and then assessing and selecting the best option. These principles and guidelines come from the experience of the U.S. Army Corps of Engineers, Bureau of Reclamation, and Natural Resources Conservation Service (USACE 2008):

1. **Identify problems and opportunities.** Consider potential problems (such as coastal development resulting in the loss of ecosystem services) and opportunities (such as creating a marine protected area to increase fishery stocks). Ideally, one should move beyond the local perspective and consider the resource from a regional or national perspective.
2. **Take inventory.** Determine the current state of the resource, including ecosystem services provided, and future development pressures.
3. **Decide on a focus.** Consider the problems and opportunities identified in step 1, and decide which ones to investigate further.
4. **Consider the options.** Define the alternative options for the management of the resources—for example, development, no development at all, or a modified development plan with fewer negative impacts.
5. **Assess the options.** Use an assessment method to weigh the effects of various options, such as looking at the benefits and costs associated with each.

6. **Rank the options.** Compare the options, using the results of the assessment in the previous step, and rank plans based on net benefits. For example, the options rank might be based on the ratio of benefits to costs.
7. **Select the option.** Using all the collected information, select the management option that maximizes the benefit to the community.

The rest of this document provides additional information about how economics can be applied to coastal resource management by

- Describing different ways of assigning value to resources
- Discussing a few methods for comparing and assessing different management alternatives
- Providing several case studies that show how economic methods were applied to coastal resource management in real-life situations

Economics Defined: The Long and Short of It

"Economics is the science of choice."

Nobel laureate Robert A. Mundell, *Man and Economics: The Science of Choice*, 1968

"Economics is the study of how men and society end up choosing, with or without the use of money, to employ scarce productive resources which could have alternative uses, to produce various commodities and distribute them for consumption, now or in the future, among various people and groups in society."

Nobel laureate Paul A. Samuelson, *Economics*, 1970.

How Much Are Resources Worth?

One of the most common ways of using economics to help manage coastal resources is to estimate how much resources are worth. Knowing the value of resources will help society make better decisions about the use, or non-use, of those resources and maximize the benefits.

However, assigning values to resources can be challenging:

- Value is often associated with what is important or what has meaning—which isn't always easy to put in terms of dollars.
- Value depends on a person's preferences and how those preferences contribute to that person's welfare. A community will contain many different ideas about how valuable a resource is, depending greatly on how the individual community members interact with the resource now.

The management of coastal resources can be complex, so a simpler example is better for illustrating the challenges of assigning value to a resource, in this case, a carton of eggs. What is the value of the eggs? To the person selling the eggs, the value might be the selling price. To the person buying the eggs, the value might be in their nutritional content, their flavor, or in the enjoyment of cooking them. All of these are valid ways of considering the worth of the eggs, but some of them are easier to measure than others.

The different types of value can be grouped broadly into two categories: market and non-market values. Market values are the easiest to calculate, but non-market values are usually more important to estimate if you want to determine the true worth of a coastal resource. Non-market values are categorized according to use. The aggregation of use and non-use values is the "total economic value" of the resource. Unfortunately, non-market values can also be costly and difficult to estimate.

In many situations where economic values are necessary for coastal management, there may not be enough time or money to conduct original research to assign economic values to a resource. A potential solution to this challenge is to use the benefits transfer methodology, which uses values from previous economic studies as approximate values of resources in similar situations.

Market Values

The economic value of some resources can be estimated by considering the market value, which is the net value (benefits minus price) of goods or services that are traded on the market. The most common measures of market value are the amount of money taken in by businesses (revenue) or the number of people with jobs (employment). Also important is the amount that people are paid for their jobs (income).

Generating a snapshot of the economic makeup of an area is one of the basic ways of using market values. To create an economic profile of an area, information such as the types of industry, employment rates, and average incomes is gathered. Although this kind of economic assessment doesn't apply directly to coastal resources, the information can be used to

- Consider potential pressures on coastal resources. Knowing about the types of industry in the area can help when estimating the types of resources that are required by industry to produce goods and services (inputs to production) and how much of the resources will be required. For example, the oil and gas industry requires coastal habitat for platforms and pipelines, uses water for extraction operations, and produces waste.
- Consider potential impacts that resource management actions may have on the local economy, using knowledge about the number and types of jobs as an indicator of how the local population earns its livelihood.

To estimate the market value of coastal resources, the first step would be to estimate direct impact: the sales, income, and jobs directly related to the resource. However, there are other market impacts (indirect and induced impacts) that occur only as a result of the direct impacts. A direct impact is like throwing a stone in a pond, which creates ripples on the water that can then cause additional changes.

For example, people on vacation spend money on a variety of things such as food, lodging, and transportation. These are the direct impacts. To provide these goods and services to the tourists, local firms must purchase other goods and services. For instance, a hotel must purchase items such as telephone service, running water, mattresses, food, and beverages. These purchases are indirect impacts that occur as a result of the direct impact (in this case,

a tourist needing to rent a room). Additionally, the employees in the industries affected by tourism will use their salaries to purchase goods and services; these are induced impacts. If the tourism in the area declines, employees will be laid off, and that may result in a decline in local businesses where the employees spend their salaries. All of these impacts can be calculated in dollar values and used to estimate the market value of the resource.

For coastal management, market values are extremely important ideas. Any management action taken by coastal managers has the potential to affect the local or regional economy. Being familiar with market concepts will not only contribute toward informed decisions—it will also aid in making those decisions more acceptable to those whose livelihoods are potentially affected.

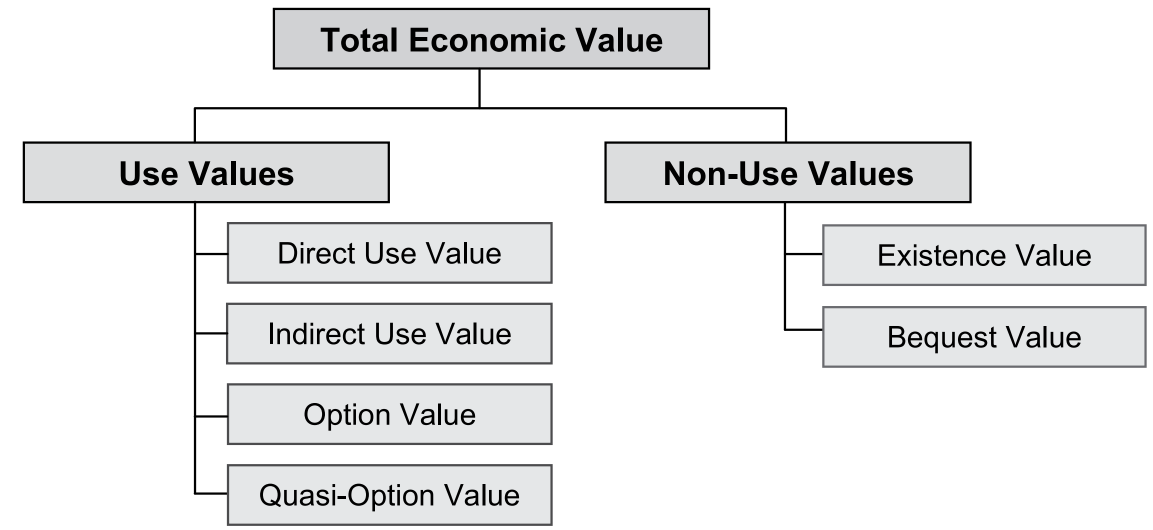
For example, creating no-fishing areas along the coast may help restore fisheries stocks in the area—both in the number of fish and the variety. A decision like this will have some negative effects on the local economy in the near term: commercial fisherman may earn less money, and there may be a decrease in tourism from recreational fisherman. So how can this decision be made acceptable to the local community? Keeping the local fisheries healthy is important to the livelihood of the community, and if it can be shown that this decision will be economically advantageous in the long term as the number of fish increase, the fishing community may be more willing to accept some short-term negative impacts.

Market values are the easiest values to calculate, but often more knowledge is gained about a resource by estimating its total economic value.

Most of the goods and services derived from coastal resources (such as recreation and flood protection) aren't traded on a market.

Total Economic Value

The total economic value of a resource can be calculated by determining the non-market use and non-use values and then adding them all together (as shown in the figure below).



Because it is not always possible to calculate an estimate for all these values (because of time or funding constraints), resource managers usually are not able to estimate total economic value. However, if only some of the values are included, the resource may be undervalued in the assessments.

Non-Market Values: Use Values

Any type of non-market economic value that is related to the usefulness (or consumption) of a resource is considered a use value. These types of value may also be called instrumental values. Typically use values make up most of the total economic value, because they are easier to assign dollar values to than non-use values. However, because use values aren't traded on the market, assigning a dollar value to them is still more difficult than it is for market values.

Four examples of use values are

- **Direct Use Value:** The current use value of a resource, based on using the resource itself. Direct use values are consumptive uses, such as cutting a tree for firewood or harvesting nuts to eat. Most people think of value in terms of direct use of a resource.
- **Indirect Use Value:** The current use value of a resource, based on using the resource indirectly. Indirect use values are non-consumptive uses, such as viewing scenery, hiking in the wilderness, or conserving wetlands that support fisheries.
- **Option Value:** The future use value of a resource. For example, keeping resources, such as a lake, available and pristine for future generations. Option values can include consumptive and non-consumptive uses.
- **Quasi-Option Value:** The potential future use value of a resource. For example, a wetland may be the home of a plant, which we will later discover has medicinal uses. Eliminating the wetland would prevent that medicine from being used, so this is another type of use value that can be estimated—although it is much harder to assign dollar values to quasi-option values.

Because use values aren't traded on the market, economists have developed techniques to assign dollar values to these types of non-market values by estimating people's willingness to pay for an environmental improvement (or their willingness to accept compensation for an environmental degradation).

There are a variety of methods to estimate the non-market value of coastal resources, two of which are briefly discussed below.

Travel Cost Method: This method assigns a value to recreational services provided by coastal resources, using the cost of travel as an approximate for price. A sample of the people who use the resource for recreation are surveyed about the number of trips that they've taken, the costs incurred in travel to the site (such as hotel costs and park entrance fees), and other factors that may affect their demand for the resource (such as income and demographic variables). The survey results are used to estimate the difference between what the consumer paid for the resource and what they would be willing to pay.

When this difference is to the consumer's benefit, it is called the consumer's surplus, and it can be used to approximate the dollar value the consumer places on the resource.

Hedonic Price Method: This method is based on the idea that there is a connection between a public good (such as beaches) and the demand for a private good (such as real estate). Specifically, this method involves creating a model in which, for example, the price of a house relates to the attributes (such as proximity to the beach, distance to a central business district, square footage, and neighborhood characteristics) that might affect price. To use this method, you would look at how one attribute (such as beach quality) would change the price of the house. If a decline in beach quality would lead to a decline in housing prices near the beach, then that dollar value can be used to estimate the non-market indirect use value of the beach.

The feasibility of the hedonic price method depends in large degree, in this case, on the availability of data both on house prices and on the attributes used. Specifically, the way in which the attribute to be valued (such as beach quality) is measured will be extremely important to the accuracy of the results.

As challenging as non-market use valuation may be, the method at least produces concrete illustrations of the value people place on resources. Non-use values are much more obscure, and their estimation is therefore more difficult.

Non-Market Values: Non-Use Values

Any type of economic value that is unrelated to the usefulness (or consumption) of a resource is considered a non-use value.

> *Non-use values are values that accrue to people who will never use a resource directly, but who still value it.*

Two examples of non-use values are

- **Bequest Value:** Value derived through preserving a resource for future generations. This value is based on the belief that people have a responsibility to provide for future generations by curtailing current consumption, including the use of natural resources. Thus, some resources may be conserved, not for the current or future benefit of the person choosing to conserve them, but for the benefit to future generations. Although this type of value is widely understood and acknowledged, it is difficult to incorporate it into a coastal management framework because of the complexity involved with assigning a specific dollar figure to it.
- **Existence Value:** Value derived from the appreciation of something for its own sake, which does not require contact or proximity. For example, some people care deeply about the health of coral reefs in the Northwest Hawaiian Islands—even though they may not ever plan to go there. Existence values are among the most difficult to identify and estimate. Some people believe that existence values are intrinsic values (values that are related to the resource itself, rather than its uses), because existence values are unrelated to human beings altogether (Pearce and Turner 1990). Intrinsic values are just as legitimate as instrumental values, but estimating intrinsic values can be more costly and contentious.

One of the most common methods of estimating non-use values is the contingent valuation method. This method uses a survey that describes the resource being valued and then asks the people taking the survey to indicate whether they would be willing to pay for specific environmental improvements or whether they would accept environmental degradation (Mitchell and Carson 1989). The results from all the survey participants are added together and then divided by the number of participants to find the average value for willingness to pay and willingness to accept. These numbers are then used to estimate the value of the resource by assuming these are the typical responses for everyone who uses the resource—not just the survey participants.

Evaluating Alternatives Using Economic Methods

Economists have developed a number of tools that use measures of value to help choose the goods and services that make people as well off as they can be. Below are three common economic methods that coastal resource managers can use to help evaluate alternative options:

- Benefit-Cost Analysis
- Cost-Effectiveness Analysis
- Incremental Analysis

Weighing Personal Values against Public Values

As discussed earlier, people will each value a resource differently according to how they feel about the resource and how they interact with it. One of the goals of a coastal resource manager is to consider all of those different ideas of value in order to determine a value for the resource that reflects the worth of the resource to the entire group. This is an already challenging task, but it is made harder by *externalities*.

An externality is a benefit received (or a cost paid) by someone who isn't directly involved in an economic transaction. When a resource is being purchased, the natural tendency of the purchaser is to place more importance on the benefits he or she will receive—than on the possible benefits to others.

The ability to impose costs on others (such as those associated with increased pollution) or the inability to be compensated for the benefits provided to others (such as the contributions natural habitat makes to local fisheries) often puts the interests of landowners at odds with those of society at large. The benefits that accrue to society from conserved lands are externalities to the landowner, which tends to tip the balance in favor of development (Krutilla 1967, King 1998, Bennett and Morrison 1999).

Benefit-Cost Analysis: Apples to Apples Comparisons

Use benefit-cost analysis when

- There are two or more alternative options about how to manage a resource, and
- Dollar values can be assigned to all the benefits and costs.

Here's an example: A port city wants to decide if the benefits of a deeper harbor outweigh the costs associated with deepening and maintaining the harbor. To begin the analysis, the city would need to identify all the benefits and costs associated with the alternative options—in this case, to deepen the port or keep it as is. The benefits and costs should cover the entire scope of the project, including design, implementation, and maintenance. Some sample benefits and costs for one alternative are shown below.

Alternative 1: Deepening the Port

Costs	Benefits
Administrative overhead (e.g., designing the plan, getting permits, overseeing the operation)	Larger, more efficient ships can use the port
Dredging equipment	Lower cost of imported goods
Contractors to run the equipment	Lower shipping costs for exported goods
Sediment disposal costs	Fewer tidal delays
Adjustments to port facilities to allow for larger ships and increased traffic flow (such as adding additional docks and port personnel)	Fewer accidental groundings
Maintenance costs to keep the sediment from building up again	Increased volume of cargo can be handled with existing port facilities

In this type of analysis, as many costs and benefits as possible should be considered, but there may still be some unintended results. For example, deepening the harbor might release toxic chemicals trapped in the sediment, impact marine life, increase noise and local pollution (from increased ship traffic), or decrease global pollution (from more efficient ships). Sometimes these items can be foreseen, but they are often hard to measure. These externalities tend to be underrepresented in benefit-coast analyses.

Once the benefits and costs have been identified, dollar values should be assigned to all of them. One way to conduct a benefit-cost analysis is to calculate a benefit-to-cost ratio based on dollar values for each alternative option, and then compare those ratios to determine the most effective alternative.

Long-Term Dollar Values Must Be Discounted

The dollar values associated with long-term costs and benefits need to be adjusted, because a dollar received today is considered more valuable than one received in the future. Applying a discount rate helps to ensure that dollar values associated with long-term costs and benefits can be compared equally against the values of short-term cost and benefits.

The discount rate is the rate at which society as a whole is willing to trade off present for future benefits, and it helps to account for inflation and other factors. However, determining the discount rate can be a source of controversy, so it should only be calculated by someone with an economics background.

For more information, see *www.csc.noaa.gov/coastal/economics/discounting.htm*.

Cost-Effectiveness Analysis: Apples to Oranges Comparisons

Use cost-effectiveness analysis when

- There are two or more alternative ways to achieve the same goal or to produce the same type and level of results, and
- It isn't possible—or practical—to assign dollar values to all of the benefits.

Cost-effectiveness analysis allows people to compare different alternatives, even when dollar values can't be applied to the benefits. That is, it allows the comparison of items with a dollar value (apples) to items without a dollar value (oranges).

To use this method, the dollar values for all the costs associated with each alternative would be estimated. If there are short-term and long-term values, the long-term values will need to be discounted so that all the costs can be added together to get the total cost for each alternative. Since all the alternatives yield similar outcomes, there is no need to estimate their dollar value; the most cost-effective means of achieving the desired outcome is chosen.

If the alternatives are significantly different in scale, this method can't be used to identify the best alternative. However, it can still allow cost considerations to be incorporated into the decision-making.

Here's an example: A dam is blocking several types of salmon from travelling upriver to spawn, which has resulted in a decrease in the salmon population and decreased tourism in the area because of fishing restrictions. The resource manager in charge of the fisheries wants to determine the best method to ensure that specific types and numbers of salmon can get upriver. The manager can use a cost-effectiveness analysis to determine which method is the least-costly means of achieving this goal—without having to assign dollar values to the benefits associated with the improvements to the fisheries stock.

Incremental Analysis

Use incremental analysis when

- Alternatives will produce similar benefits, and
- Alternatives differ primarily in the amount (or size) of the benefit.

Instead of assigning dollar values to the benefits (as would be done in a benefit-cost analysis), this method only requires that the benefits be quantified in some manner, such as the amount that different alternatives would decrease phosphate in the water. Next, all the costs associated with the alternatives would be considered to determine which alternative was the most cost-effective for the benefits it produces. Like the other methods discussed, long-term costs need to be discounted.

Here's an example: A plan has been proposed to restore the salinity of a wetland. This plan includes several different components, like replacing undersized culverts and reopening several of the original channels. The groups funding the project want to know how cost-effective each component is, so that they can determine if any should be eliminated from the plan.

To make this determination, they perform a cost-effective analysis for each component that is being considered. Each component has the same benefit (restoring the salinity of the wetland), so it is not necessary to estimate the monetary value of the expected salinity changes. Instead, they need only to estimate the salinity change (benefit) and monetary cost of each component and convert these to some meaningful ratio (degree of change per dollar). If any component provides too little benefit to justify the cost, it can be eliminated from the plan (or replaced with a better option).

Case Studies

Three case studies are summarized on the following pages to illustrate how economic methods are applied to coastal resource management in practice:

1. Estimating Non-Market Values of Coastal Marshes (Whitehead and others 2006)
2. The Value of a Coastal Wetland (Barataria-Terrebonne NEP 1996)
3. Management of a Man-Made Lake (Washington State 2007)

Note: The economic methods and concepts discussed in this document are only a brief introduction to this field of study. The case studies on the following pages include real-life examples and a few terms that haven't been discussed. These terms are defined in the glossary.

Case Study 1: Estimating Non-Market Values of Coastal Marshes

Saginaw Bay is an extension of Lake Huron that separates Michigan's "thumb" from the rest of the Lower Peninsula. The watershed that drains into Saginaw Bay is Michigan's largest, encompassing nearly 9,000 square miles and including at least part of 22 counties. It is home to 1.4 million people.

The Saginaw Bay watershed is rich in resources that support agriculture, manufacturing, tourism, and outdoor recreation. Its resources also provide habitat for a wide variety of wildlife, including songbirds, waterfowl on the Mississippi Flyway, and 138 threatened or endangered species.

People care about all these things, which places many—often competing—demands on the resources of the watershed. Making good choices about how to meet those demands requires a careful assessment of a wide range of trade-offs. In each decision, resource managers must assess what will be gained and what will be given up.

Resource management decisions are further complicated by the fact that some of the goods and services supported by the watershed resources are commonly bought and sold, and some are not. For example,

- It is relatively easy to assess the value of the sugar beets and auto parts that are produced in the watershed. People's willingness to pay for these items, one of the best measures of value, is demonstrated in the marketplace every day. Data are collected by businesses, reported to the government, and continuously analyzed by researchers and industry experts.

- It is much harder, though, to assess the value of bird-watching or of preserving endangered species whose existence is not widely known and whose ecological significance is not widely appreciated. These non-market goods and services have real economic value, which may be significant. However, because no one pays for them (or earns money on them), their value is often treated as zero in public decision-making.

Luckily, resource managers can use economic tools and methods to estimate the value of non-market goods and services to compare them alongside market values. This will allow managers to avoid trading things that are worth more to the community for things that are worth less.

In 2005, a study was conducted to estimate the value of wetlands in Saginaw Bay. The study used two variations of the travel cost method to estimate the recreation values of Saginaw Bay coastal marshes by looking at the money spent by people who use a "free" resource as they travel to and from the site:

- The first variation looked at visits to a single site to determine the factors that influenced the number of visits to that site. This information was used to estimate the total value of Saginaw Bay marshes to recreational users using travel costs as an approximate.
- The second variation looked at the number of recreational sites available for use and assessed the cost and other factors that influenced which site was chosen. This information was used to estimate the value of adding to the existing acreage available for recreational use.

Each year Saginaw Bay wetlands provide $16 million of non-market benefits to recreational users, yielding a total value of $239 million.

However, the study also found that the value that people place on these wetlands is not limited to their recreational use. For example, people place a value on the preservation of threatened and endangered species of wildlife.

One of the survey questions asked people how much they would give in a one-time donation to a hypothetical "Saginaw Bay Coastal Marsh Trust Fund" to avoid the loss of specific non-market goods. Resource managers were able to use the contingent valuation method to use the responses to this question to estimate the value of preserving additional wetlands (or the cost of losing them). They estimated an additional value of Saginaw Bay wetlands to be about $3,600 per acre—less than half of which accrues to recreational users.

The remaining value of the wetlands represents the value to the public of the other non-market goods and services provided by the wetlands. The study concludes that, "[a]s wetlands are lost, these values are lost."

Case Study 2: The Value of a Coastal Wetland

Coastal wetlands are one of the nation's most valuable resources, providing direct values (such as recreation) and indirect values (such as flood protection). Often, wetlands are also valued for their development potential. How do practitioners assign dollar values to these very different benefits?

The Barataria-Terrebonne estuarine system offers an example. These extensive wetlands are a valuable source of oil and gas, and they are also valued for fishing, hunting, and wildlife viewing. State officials were interested in placing a dollar value on these wetlands for two reasons:

- To compare the estimated costs for conserving the system's resources to the benefits associated with the conservation effort
- To help people see that protecting these resources can be economically beneficial in the long term

Once the types of values to be investigated were defined, several methods were used to estimate dollar values:

- Benefits transfer was used to estimate the value of recreational services. From a non-market value perspective, the economic benefits accruing from recreational activities ranged from $327 million to $1 billion.
- IMPLAN (Impact Analysis for Planning), a regional economic model, was used to estimate the market value of estuary-dependent industries to the local economy. Examples of estuary-dependent industries include oil and gas production, aquaculture industries, and commercial fishing, hunting, and trapping. The estuary's role in the commercial economy was about $3.5 billion (of which about $2.3 million was from oil and gas production).
- Avoided cost method was used to estimate the value of other wetland services on an annual, per-acre basis. Examples include protection from hurricane damage ($186), storm surges ($280 to $904), damage to the water supply ($84 to $157), and property losses from inundation ($6,599 to $7,116).

The results of this study (all in 1994 dollars) show an extremely valuable resource with a diverse set of services. These results have been used to evaluate management options and justify conservation efforts, which in some cases resulted in curtailing certain economic activity and completing other measures to ensure that the region's way of life could be sustained.

Case Study 3: Restoration of a Man-Made Lake to an Estuary

Capitol Lake provides a reflecting surface for the Washington State Capitol Building. This man-made lake was created in 1951 by building a dam on the Deschutes River, which prevents the water in the river from flowing into Budd Inlet and Puget Sound. Maintaining the artificial lake has caused several problems, including sedimentation, invasive species, and compromised water quality.

The state officials in charge of maintaining the lake wanted to evaluate the feasibility of restoring Capitol Lake to its original estuary state. To determine the best way to manage this resource, they wanted to know how much it would cost to keep maintaining the lake and how much it would cost to eliminate the lake. Some of the costs (such as removing the dam) were easy to estimate, while others (such as decreased aesthetic value and recreational services) were more complicated to estimate.

To better understand the restoration options, economists used the following process:

- Establish the geographic scale of the study (that is, the areas that are going to be impacted)
- Identify the existing conditions of the lake
- Assemble information about the physical or biological changes that estuary restoration would cause
- Determine general economic effects (both quantitatively and qualitatively) of those physical or biological changes

This process was used to determine the economic impacts of restoration on infrastructure (including ports), tourism, and the categories of ecosystem services denoted in the Millennium Ecosystem Assessment. Primarily, the benefits transfer and avoided cost methods were used to determine the costs of estuary restoration.

In general, the results were a mixture of qualitative and quantitative results—and they weren't easy to compare. In the end, the investigation team decided to look at each category individually and determine whether the economic impact from estuary restoration was

- Positive
- Negative
- Unknown (not enough information about future conditions to make a determination of the economic impact)
- Divergent (there are strongly held perspectives in the community on whether the change is positive or negative, but there is insufficient information to determine the absolute direction of the net effect)

Several phases of the feasibility study are complete, but there is still more information to collect before a decision about the potential estuary restoration can be made. Having a better understanding of the economic benefits for a wide variety of ecosystem services will help the community make a better-informed decision.

Conclusion

This document provides a brief overview and examples of some of the economic tools used by those who manage coastal resources.

Although application of economic principles to environmental choices can be challenging and costly, the use of these tools can go a long way toward making sure the community is as well off as possible from a social, economic, and environmental perspective. When the community knows the complete value of a resource, it is less likely that decisions will be made that result in valuable resources being traded for less valuable ones.

Glossary of Economic Terms

Avoided Cost Methodology – An approach to estimate the economic value of environmental services from the cost of avoiding damages caused by lost services or the cost of providing substitute services.

Benefit-Cost Analysis – A method for comparing the benefits and costs of alternatives whose effects can be well represented in monetary terms.

Benefits Transfer – An approach to estimate economic values by borrowing estimates for environmental goods or services and applying them to the same goods or services in a new location or setting.

Bequest Value – The value derived through preserving a resource for future generations.

Consumer's Surplus – The aggregate of the net of what someone has to pay for a good or service and what he or she would be willing to pay.

Contingent Valuation – A method for estimating non-use values using a survey to determine what people would be willing to pay for specified changes in the quantity or quality of the resource—or, more rarely, what they would be willing to accept in compensation for a decline in the quantity or quality of the resource.

Cost-Benefit Analysis – See Benefit-Cost Analysis.

Cost-Effectiveness Analysis – A method for comparing alternatives to determine the most cost-effective means of producing a result of a specified type and level.

Direct Impact – The amount of the increased purchase of inputs used to manufacture or produce the final goods and services purchased by visitors.

Discounting – Adjusting values to account for time preference.

Discount Rate – The weighting factor applied to values to account for time preference.

Ecosystem Services – Services (such as filtering and purifying runoff water) provided by natural resources that are beneficial to people.

Existence Value – The value derived from knowing that resources exist in a certain state. It is the appreciation of something for its own sake, which does not require contact or proximity.

Externality – Benefits received (or costs paid) by someone who isn't directly involved in an economic transaction (such as the view that is enjoyed by those who live near a forest or the impacts of water pollution on the populations downstream from a factory).

IMPLAN – IMPLAN (Impact Analysis for Planning) is an economic impact modeling system that estimates the multiplier effect of a change in demand in order to derive the total economic impact to an economy (in terms of revenue, employment, income, and value added). IMPLAN was originally developed by the U.S. Department of Agriculture, Forest Service.

Incremental Analysis – A method for comparing alternatives that have similar outputs in order to rank them according to their cost-effectiveness.

Indirect Impact – The value of the inputs used by firms that are called upon to produce additional goods and services for those firms first impacted directly by spending.

Induced Impact – Result from the direct and indirect effects of spending. Induced effects are related to persons and businesses that receive added income as a result of local spending by employees and managers of the firms and plants that are impacted by the direct and indirect effects of direct spending. This added income results in increased demand for goods and services and, in turn, increased production and sales of inputs.

Inputs to Production – The resources used in producing goods and services, including land, labor, and capital.

Instrumental Value – Refers to something that is valued because of its usefulness, or because it provides a means to some other goal.

Intrinsic Value – Refers to something that is valued for its own sake.

Market Value – The net value (benefits minus price) of goods or services that are traded on the market.

Non-Market Value – The net value (benefits minus price) of goods, services, or states of nature not traded on the market (such as a day of fishing). The price is often approximated by looking at the cost of travel (see Travel Cost Method).

Non-Use Value – Economic value unrelated to use or consumption. Non-use values may include existence values, option values, quasi-option values, or bequest values.

Option Value – Values based on the option to use coastal resources in the future.

Quasi-Option Value – Values based on the potential option to use coastal resources in the future—even though the values may not yet have been identified. The value would be lost if the resource is diminished (or not preserved).

Time Preference – People's tendency to care more about today's consumption than tomorrow's and to believe that we will be better off in the future than we are today.

Total Economic Value – The sum of use and non-use values.

Travel Cost Method – A methodology that relies on travel-related costs as a proxy for price in a non-market valuation analysis in order to estimate net economic values.

Use Value – Economic value related to use or consumption. Use values may include both direct, consumptive uses (such as cutting a tree for firewood) and indirect, non-consumptive uses (such as viewing scenery).

Willingness to Accept – How much people say they would be willing to accept in exchange for foregoing an environmental improvement (or accepting a decrease in environmental quality). This is useful when trying to estimate non-market values.

Willingness to Pay – How much people say they would be willing to pay for an environmental improvement (or to avoid a decrease in environmental quality). This is useful when trying to estimate non-market values.

References

Barataria-Terrebonne National Estuary Program (NEP). 1996. *Economic Value Assessment for the Barataria-Terrebonne Estuarine System.* Barataria-Terrebonne National Estuary Program. Thibodaux, LA.

Bennett, J., and M. Morrison. 1999. "Valuing Wetland Rehabilitation." *An International Perspective on Wetland Rehabilitation.* Pages 217 to 224. Kluwer Academic Publishers. Dordrecht, the Netherlands.

Boyd, J., J. Sanchirico, and L. Shabman. 2004. "Habitat Benefit Assessment and Decisionmaking: A Report to the National Marine Fisheries Service." Resources for the Future. Washington, D.C.

English, D.B.K., W. Kriesel, V.R. Leeworthy, and P.C. Wiley. 1996. "Economic Contributions of Recreating Visitors to the Florida Keys/Key West." National Oceanic and Atmospheric Administration. Silver Spring, MD.

King, D. 1998. "The Dollar Value of Wetlands: Trap Set, Bait Taken, Don't Swallow." *National Wetlands Newsletter.* Volume 20. Number 4. Pages 7 to 11.

Krutilla, J.V. 1967. "Conservation Reconsidered." *The American Economic Review.* Volume 57. Pages 777 to 786.

Mitchell, R.C., and R.T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Resources for the Future. Washington, D.C.

Pearce, D.W., and R.K. Turner. 1990. *Economics of Natural Resources and the Environment.* The Johns Hopkins University Press. Baltimore.

U.S. Army Corps of Engineers (USACE). 2008. "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." Accessed April 27, 2009, at *www.usace.army.mil/CECW/Documents/pgr/pg_draft.doc*.

Washington State. General Administration. 2007. "Capitol Lake Adaptive Management Plan." Accessed May 12, 2009, at *www.ga.wa.gov/CLAMP/Plan.htm*.

Whitehead, J.C., P.A. Groothuis, R. Southwick, and P. Foster-Turley. 2006. "The Economic Values of Saginaw Bay Coastal Marshes." Department of Economics. Working Papers 06-10. Appalachian State University. Boone, NC.

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2009

EXHIBIT B

The Value of a Wave

An Analysis of the Mavericks Region
Half Moon Bay, California

This study was prepared by

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for

Save the Waves Coalition

October 2009

This study was commissioned by Save the Waves Coalition to assess the value of the Mavericks surf area. Survey instruments were developed jointly by Save the Waves Coalition and the authors. All data was collected by Save the Waves Coalition and provided to the University of Hawaii at Manoa.

"Mavericks is a great place to witness how awesome nature is – and how powerful man can be to preserve such a place."
- *Anonymous survey participant*

1. Introduction

Surfing is one the most popular ocean sports worldwide. Surfing originated in Polynesia and, in particular, in Hawaii roughly 1,000 years ago (Finney and Houston 1966, 23). Surfing was "the sport of Hawaii's kings" and was called "Hee Nalu" or "wave sliding." In 1907, an Irish-Hawaiian by the name of George Freeth introduced the sport to southern California. In 1912, Duke Kahanamoku stopped in California on his way to the Olympic competition for swimming (Finney and Houston 1966, 90-91). Kahanamoku, who is known as the grandfather of modern surfing, further popularized the sport within the southern coastline. The advent of the wet suit allowed surfing to both flourish in northern California and in the wintertime, when waves are bigger. One of the most notorious big-wave surfing spots is Mavericks, in Half Moon Bay. Big-wave surfers travel from all over the globe to ride Mavericks up to 50-foot faces.

This study was commissioned by the Save the Waves Coalition to determine the value of the Mavericks surf area to the local community and beyond. All data was collected by Save the Waves and provided to the University of Hawaii. Data was collected over a five-month period and 358 people were surveyed at the Mavericks surf area.

The survey data collected was used to build an Individual Travel Cost Model (ITCM) to estimate the annual welfare accrued by visitors to the Mavericks surf area. The average visitor is estimated to receive $56.7 in consumer surplus per trip to the Mavericks surf area. With an estimated 421,431 visitors annually,[1] the total annual net economic value to Mavericks visitors is estimated at $23.8 million. In addition, surfers are estimated to visit the area nearly five times more often than non-surfers and thus accrue more value from the area.

2. Background

There is a growing interest in understanding the value of surfing. A study on the Mundaka surf break in Mundaka, Spain estimates the economic impact of the wave to the local community through tourism revenue. The wave was of particular interest because it was a stop along the prestigious Billabong Pro surf contest prior to a 2004 river dredging project that negatively altered the dynamic of the wave (Murphy and Bernal, 2008). Similarly, a 2006 study on the Vans Triple Crown of Surfing contest on the North shore of the island of Oahu, Hawaii estimated the direct and indirect economic impacts of the 7,000 participants and spectators (Surfer Magazine, 2009).

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[1] As no other data source is available, this is based on a very generalized estimation process using a headcount of beach visitors during survey days. Details on the population estimation are provided in section 4.

These prior studies focused on the *economic impacts* of the industry to local economies. Another aspect of economic value, however, comes from the welfare or benefit that surfing provides to surfers and observers. This perspective takes that of "consumer welfare" and thus focuses on economic *value* rather than economic *impact*.

2.1 Valuation Techniques

Economic valuation of environmental services and amenities is based on peoples' willingness to pay for such environmental goods and services. There are three basic components of value, where an individual's total willingness to pay is composed of willingness to pay for "use value," "option value," and "intrinsic value" (*Total Willingness to Pay = use value + option value + intrinsic value*). Use value is the direct benefit derived from consumption; option value is the benefit derived from having the choice to consume (i.e. the possibility of use in the future); and intrinsic value, also known as existence value, is the benefit from knowing a good exists (Tietenberg, 2007). Because markets are notoriously poor at properly valuing environmental amenities (due to issues of common property, public access, and a host of issues associated with externalities), the value of environmental goods and services must often be assessed using methods other than market observation.

Many valuation techniques are based on the tradeoffs or sacrifices that people make in their life choices; such as paying more for houses in areas that are perceived as of higher environmental quality, or accepting a reduction in income for living in such areas or traveling to visit these areas in lieu of other recreation activity.

Valuation techniques are either based on information revealed through consumer actions or inferred based on stated preferences. Revealed preference methods are based on peoples' past behavior. Revealed preference methods assess "use value," and, in some cases (hedonic pricing), "option value." Stated preference methods can assess all three values. Stated preference methods are accompanied, however, by the challenges of positing hypothetical scenarios that people may or may not perceive as realistic.

This report uses the Individual Travel Cost Method (ITCM) to assess the value (welfare) accrued to the users of the Mavericks surf area. TCM is the most frequently used revealed preference method (Rosenberger and Loomis, 2000) and is widely used to establish recreational values of environmental amenities. It has been "commonly used for decades to estimate a recreation demand curve empirically" (Loomis and Keske, 2009, 428). It is considered a relatively conservative measure as it is based on a *minimum* willingness to pay assessment. This method is based in the assumption that how much people pay in their travel to a location must be, at a minimum, representative of their willingness to pay for the environmental amenity. Due to statistical inefficiency and problems with using aggregate averages associated with the Zonal Travel Cost approach, we chose to collect detailed information on individuals visiting the Mavericks region over a five-month period. Data were collected from early February through late June. This timeframe included both the end of the surf season at Mavericks beach as well as the beginning of the popular summer tourist season, which brings visitors to the Mavericks region to enjoy

the natural amenities. Details on data collection and model construction are provided in the next section.

3. Data Collection and Construction

Although a combination of on-site and on-line data was collected, only the on-site data is used to inform the Individual TCM model and, ultimately, to estimate of the value of the Mavericks surf area. This decision was made because the on-line survey inherently suffers from selection bias, attracting those who are affiliated and/or familiar with Save the Waves Coalition rather than being more representative of the beach visitor population.

The on-site surveys were collected over nine survey days, ranging from February 7 through June 27, 2009. In this time, 359 surveys were conducted.[2] Survey questions ranged from modes of travel to reasons for visiting the Mavericks surf area to describing the primary reasons for the trip. These reasons included: to surf, to watch the surf, for the surfing community, to see the waves, and to visit family and friends. For the full survey instrument, see Appendix I.

In addition, zip codes and car types were collected in order to assess the distance and cost of travelling to visit the Mavericks surf area. If someone traveled through a mode other than a passenger vehicle, that information (e.g., cost of airline ticket) was also recorded. To assure that the entire value of the trip was not unduly attributed to the visit to Mavericks, participants were asked whether Mavericks was the primary purpose of their trip. If so, the entire cost of the trip was attributed within the "travel cost" estimate. Otherwise, only half the value of the trip was attributed as such.

For visitors using passenger vehicles, travel cost was calculated to be the two-way distance traveled divided by the fuel economy of the vehicle multiplied by the cost of gasoline. Passenger vehicles were divided into compact, sedan, and S.U.V. categories and the average fuel economy for each general type were taken from the Environmental Protection Agency (http://www.fueleconomy.gov/). The average price of gasoline in the Half Moon Bay area during the study period was $2.95 (http://www.eia.doe.gov/).

Demographic variables were also recorded, as factors such as age, income, and gender are expected to influence the number of annual trips to the Mavericks region. Summary statistics for our variables of interest are provided in Table 1.

[2] For comparison, Loomis and Keske (2009) collect data on hiking in Pikes Peak over five separate days. A total of 206 surveys were distributed there was a response rate of 55% (due to the mail-back aspect). They had 89 usable observations.

Table 1. Summary Statistics.

Variable	No. of Observations	Mean	Standard deviation
Annual trips	359	17.64	48.23
Travel cost	359	19.18	114.60
Age	224	44.57	16.39
Income	195	94,297.08	91,280.96
Gender (female=1)	359	0.24	0.43
See Waves	359	0.08	0.28
Watch Surfing	359	0.03	0.18
To surf	359	0.07	0.26
Surfing Community	359	0.01	0.07
Family and Friends	359	0.14	0.35

Because there were incomplete responses for the age and income categories, these observations were dropped from the dataset (leaving 195 usable observations). Due to the large standard deviation associated with the travel cost variable, and because most responses were people from the local area, we truncated the data by including only those visitors with an average travel cost of $100 or less. This decision was made to address those who flew to California, because it was difficult to determine what portion of the cost of their flight was attributable to their trip to Mavericks. This brought us to a final data set of 151 observations.

4. Methodology: An Individual Travel Cost Model

The Individual Travel Cost Model uses annual trips per person as the dependent variable, and uses travel cost and other relevant factors as explanatory variables. The simplest version would use travel cost alone to estimate how many trips the average visitor makes to the Mavericks area. Other factors that are likely to explain visitation rate are characteristics such as the visitor's interests in the area (surfing, friends and family, etc.), and demographics such as age, income, and gender.

Once the appropriate explanatory variables have been assembled, the regression equation gives us the demand function for annual trips for the "average" visitor to the Mavericks region, and the area below this demand curve provides an estimate of the average consumer surplus. We then multiply average consumer surplus by the total relevant population to produce an estimate of total consumer surplus for the Mavericks region.

A general equation describing annual trips to the Mavericks region is given by Equation (1).

$$AnnualTrips_i = \beta_0 + \beta_1(TC_i) + \beta_2(X_i) + \beta_3(reasons_i) \qquad (1)$$

where $AnnualTrips_i$ is the number of trips made by visitor i in one year, TC_i is travel cost of visitor i, X_i is a vector of demographic variables describing individual i, and $reasons_i$ is a vector of reasons individual i visited the Mavericks surf region.

Functional forms often used to address count data (data in which the observations can take only non-negative integer values and where these integers arise from counting rather than ranking) are either Poisson or negative binomial models. These are commonly used functional forms associated with Travel Cost Models (Wang et al. 2009). We began our analysis with the Poisson model, but ran into issues with overdispersion— that is — greater variance than might be expected in this type of distribution, resulting in failures of standard goodness-of-fit tests.[3] The large value for chi-square in our goodness-of-fit test was another indicator that the Poisson distribution was not an adequate functional form. We followed the Poisson model with a negative binomial regression, as the negative binomial regression is often more appropriate in cases of overdispersion. The likelihood ratio test provided by Stata's negative binomial command is a test of the overdispersion parameter alpha.[4] When the overdispersion parameter is zero the negative binomial distrbution is equivalent to a Poisson distribution. In our case, alpha was significantly different from zero, reinforcing that the Poisson distribution was not appropriate. However, the negative binomial regression provided very poor Pseudo R^2's in most sensible specifications. Following Loomis et al. 2009, we then turned to Ordinary Least Squares (OLS) using a semi-log model.

The semi-log functional form mimics the functional form associated with count data models (Loomis et al. 2009). The other benefit of using a semi-log functional form is that it simplifies the consumer surplus calculation in comparison to other OLS specifications. In this case, consumer surplus per trip is simply the reciprocal of the travel cost coefficient (Creel and Loomis 1990). The natural log of the dependent variable also allows for nonlinearity in the demand function. To correct for heteroskedasiticity we use White's heteroscedastic-consistent standard errors. Because the fewest number of trips per year was (by definition) one, the log form meant that the lowest dependent variable was zero. For this reason, we tried the specification with and without a constant term.[5]

The final specification of our individual travel cost model is given in Equation (2).

$$\begin{aligned} lannualTrips_i &= \beta_0 + \beta_1(TC_i) + \beta_2(Age_i) + \beta_3(Income_i) + \beta_4(Gender_i) \\ &+ \beta_5(SeeWaves_i) + \beta_6(WatchSurf_i) + \beta_7(Surf_i) + \beta_8(FamFrnd_i) \end{aligned} \tag{2}$$

where $lannualTrips_i$ is the natural log of the number of trips made by visitor i in one year, Age_i is an indicator variable representing individual i's age category[6], $Income_i$ is an indicator variable representing individual i's income category[7], $Gender_i$ is an indicator

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[3] A significant ($p<0.05$) test statistic from the goodness-of-fit indicates that the Poisson model is inappropriate.

[4] All statistical estimations were performed in Stata 9.0 (StataCorp LP).

[5] In addition, an "opportunity cost" variable based on travel time was constructed. It was omitted, however, as travel time and travel cost were too highly correlated.

[6] The age categories were coded as 1: 18-25, 2: 26-29, 3: 30-39, 4: 40-55, 5: 56-70, and 6: 71+.

[7] The income categories were coded as 1: <$10k, 2: $10k-$29.9k, 3: $30k-$59.9k, 4: $60k-$89.9k, 5: $90k-$119.9k, 6: $120k-$200k, and 7: $200k+.

variable representing individual i's gender[8], $SeeWaves_i$ is a dummy variable indicating whether individual i visited Mavericks to see the waves, $WatchSurf_i$ is a dummy variable indicating whether individual i visited Mavericks to watch other people surfing, $Surf_i$ is a dummy variable indicating whether individual i visited Mavericks to surf, and $FamFrnd_i$ is a dummy variable indicating whether individual i visited Mavericks to see family and friends. All other variables are as described in Equation (1). The reason "Surf Community" was dropped from the model because it was too highly correlated with other reasons to the visit the Mavericks surf area.

4.1 Population Projection Estimate

Total recreational visitor use is often quite difficult to calculate (English et al., 2002). This is particularly true in the case of an open-access amenity like the Mavericks surf area. In other such cases, like Loomis and Keske's (2009) analysis of the value of Pikes Peak in Colorado, they focus solely on individual consumer surplus and do not scale their findings to the general population. For this study, however, a headcount of beach goers was taken for each site visit, including the duration of time for which the headcount was valid (i.e. the amount of time spent surveying). For example, on February 7, 2009, a total of 56 people were surveyed during a three-hour period. In this same amount of time 450 individuals were at the beach. This allows for a very generalized estimation of the total number of visitors to the Mavericks surf area annually.

The ratio of survey participants to people on the beach was calculated and normalized by the number of hours the survey was conducted each day. This ratio was taken for each survey day. The average number of survey participants each hour was then multiplied by the average participant-to-population ratio, multiplied by 365 days per year and 8 hours per day. The 8 hours per day estimate is quite conservative, given that there are 10 hours of daylight in the winter months and 14 in the summer (US Navy, 2009).

$$V = \sum_{i=1,..,d} P \Big/ d * t_i * \sum_{i=1,...,d} \frac{H_i}{P_i} \Big/ d * days \big/ year * hours \big/ day \tag{3}$$

where V is total annual visitors (includes double-counting); i is the respective survey day $1,\ldots,\ d$ where d is the number of total survey days; t is the amount of time spent surveying on each day i in hours; H is the headcount taken on each survey day i; and P is the survey participants on each survey day i.

Using this equation, there are an estimated 421,431 visits to the Mavericks surf area annually. This is clearly a very general estimate using a simple scaling process. Yet there is no other visitation data for the Mavericks surf area. For reference, Half Moon Bay State Beach Park, several miles down the coast, is estimated to have an annual visitation of 990,406 (California State Parks, 2008). From conversations with Save the Waves Coalition staff and representatives from the Half Moon Bay Chamber of Commerce, it

[8] Female=1.

seems consistent that the Mavericks surf area should have considerably fewer visitors than the larger State Beach Park.

It is also important to note that this study is estimating the annual economic benefit of the Mavericks surf region, not the Mavericks surf contest. Our annual calculation of 421,431 does not include contest activity, as the 2009 holding period did not result in conditions adequate for the Mavericks surf contest. In the past, the Mavericks surf contest has drawn between 10,000 and 50,000 visitors in a single day, depending on the year and the source.[9] For a template of how to estimate the consumer surplus of a one-time event such as the Mavericks surf contest, see Appendix II.

5. Findings

The estimated demand functions are reported in Table 2. The first specification reports the demand function with no constant parameter and produces an R^2 of 0.54. As expected, the coefficient on travel cost is negative and highly significant. Also statistically significant are the demographic variables age and gender, at the 5% level. Another useful aspect of the semi-log model is the ease of interpreting the coefficients. The slope coefficient is the ratio of the proportionate change in annual trips to the absolute change in the explanatory variable. For example, an additional dollar added to the cost of travel decreases annual trips to the Mavericks region by 1.76%. Moving up an age category increases annual visits by 21.9%. Our results suggest that females, on average, will visit 84% more often than males.

Notably, if an individual visits Mavericks specifically to surf, this increases both annual trips and annual individual welfare. People who come to surf Mavericks and the nearby wave breaks including Ross's Cove will visit 447.8% (nearly 5 times) more often than any other user group.

For completeness we also include an estimate including the constant parameter in the demand equation, though this model does not "fit" as well as the first specification. Nonetheless, the coefficient for Travel Cost remains statistically significant at the 1% level.

[9] Surfing Magazine reports 10,000 spectators to the March 2, 2005 contest (the Mavericks website reported 30,000 for the same contest). The 2006 Mavericks event drew between 40,000 (Surfing Magazine) and 50,000 spectators (Maverick's website).

Table 2. Regression Results for Mavericks Demand Equation

	Dependent variable = *Log of Annual Trips* (no constant)		Dependent variable= *Log of Annual Trips* (with constant)	
Variable	**Coefficient**	***T* statistics**	**Coefficient**	***T* statistics**
Travel cost	-0.01764***	-2.68	-0.0207***	-3.08
Age	0.2193**	2.15	0.0908	0.66
Income	0.0979	1.17	0.0592	0.70
Gender	0.6112**	2.34	0.5195*	1.83
SeeWaves	0.4331	1.08	0.3072	0.77
WatchSurfing	0.4637	0.61	0.3622	0.52
ToSurf	1.7008***	4.52	1.5869***	4.04
FamilyFriends	0.0742	0.26	0.01871	0.06
Constant			0.7235	1.48
R-squared	0.5398		0.1179	
F statistic	24.14		4.23	
Probability (*F* statistic)	0.0000		0.0001	

*Indicates statistical significance at the 10% level, ** at the 5% level, *** at the 1% level.

The average visitor is estimated to receive $56.7 in consumer surplus per trip (calculated by the inverse of the coefficient for Travel Cost). With an estimated 421,431 visitors to the Mavericks surf area annually, the total annual net economic value to Mavericks visitors is estimated at $23.8 million. In addition, surfers are estimated to visit Mavericks near five times more often than non-surfers. This means that surfers accrue more benefit from the surf area than non-surfers over the year.

In comparison, Loomis and Keske (2009) find that hikers at Pike's Peak have a mean value of $31 per trip while Cog railway users at Pike's Peak have a mean value of $98 per trip. Loomis et al. (2009) fine that mean value of a round of golf in Colorado is $18 and the "few available downhill skiing studies have a consumer surplus of $33.50" (Loomis et al., 2009).

6. Conclusions

The Mavericks region of Half Moon Bay, California is famous for surf, whale watching, boating, and other recreational and ecotourism activities. This is the first study to quantify the benefits of visitors enjoying the natural amenities of the region, and the first study to evaluate the economic welfare that accrues to individuals associated with the sport of surfing. We develop an individual travel cost model to estimate the economic benefit for visiting the Mavericks surf area in Half Moon Bay, California. Results indicate that the average visitor to the area receives a benefit of $56.7 per trip. This amounts to a total annual economic benefit from the Mavericks region of $23.8 million.

Bibliography

California State Parks 2008. Calendar Year Attendance Report. Available at http://coastsider.com/images/uploads/2009/stateparksattendance.pdf, Accessed October 26, 2009.

Creel, M. and Loomis, J. 1990. Theoretical and Empirical Advantages of Truncated Count Data Estimators for Analysis of Deer Hunting in California. American Journal of Agricultural Economics, 72, 434-441.

English, D., Kocis, S., Zarnoch, S., and Arnold, J. 2002. Forest Service National Visitor Use Monitoring process: research method documentation. Res. Pap. SRS-57. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 14 p.

Finney, B. and Houston, J. 1966. Surfing: The Sport of Hawaiian Kings. Charles E. Tuttle Company, Inc. Rutland, Vermont and Tokyo, Japan.

Murphy, M. and Bernal, M. 2008. The Impact of Surfing on the Local Economy of Mundaka, Spain. Available at http://www.limmatwave.ch/Presse/SurfonomicsStudieMundaka.pdf, Accessed July 1, 2009.

Surfer Magazine, http://forum.surfermag.com/forum/showflat.php?Number=1467956&page=0, Accessed September 1, 2009.

Loomis, J. and Keske, C. 2009. The Economic Value of Novel Means of Ascending High Mountain Peaks: A Travel Cost Demand Model of Pikes Peak Cog Railway Riders, Automobile Users and Hikers. Tourism Economics, 15(2): 426-436.

Loomis, J., Tadjion, O., Watson, P., Wilson, J., Davies, S., and Thilmany, D. 2009. A Hybrid Individual-Zonal Travel Cost Model for Estimating the Consumer Surplus of Golfing in Colorado. Journal of Sports Economics, 10(2): 155-167.

Mavericks website, http://www.maverickssurf.com/, Accessed September 1, 2009.

US Navy, 2009 https://aa.usno.navy.mil/cgi-bin/aa_pap.pl, Accessed September 1, 2009.

Rosenberger, R. and Loomis, J. 2000. Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan. Gen. Tech. Rep. RMRS-GTR-72. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 59 p.

Tietenberg, T. 2007. Environmental Economic and Policy, 5th edition. Boston: Pearson Education, Inc.

Wang, E., Li, Z., Little, B., and Yang, Y. 2009. The Economic Impact of Tourism in Xinghai Park, China: A Travel Cost Value Analysis Using Count Data Regression Models. Tourism Economics, 15(2): 413-425.

Appendix I. Survey Instruments

On-Site Survey

Please help us determine what the Mavericks surf break means to you in order to inform future development decisions that impact waves throughout the world. You can help by completing this survey about your experience travelling to Mavericks.

Please answer all questions as an individual (i.e. if you came to Mavericks with a group, answer for yourself only). No information provided will be individually attributed to the respondent.

1) Are you at least 18 years old? Y N

2) What is your zip code? ________________

3) Tell us why you came to Mavericks: (circle all that apply)

A. To see the waves

B. To watch the surfing

C. To surf

D. To spend time with the surfing community

E. To spend time with family and friends

F. Other: ________________

3a) Which of the above was the most important reason? A B C D E F

4) Did you fly to California or within California to travel here? Y N

4a) If "Y," what was the cost of your ticket? ________________

5) Did you drive here?

5a) If "Y," what kind of vehicle do you drive? ________________

5b) If "Y," is it a rental car? Y N

6) Is visiting Mavericks the primary reason for your trip to Half Moon Bay?

7) How many times have you traveled to Mavericks in the last month? _______

7a) In the last year? ________

8) Do you come to Half Moon Bay when there is no surf at Mavericks? Y N

9) By the time you leave, how many days will you have stayed in the area? ____________

10) Where are you staying? (circle one) Hotel Motel With friends/relatives Camping Other _______

11) What was the most important factor in your choice of accommodations? (circle one)

Price Environmental-Concerns Location Other ____________________

12) Approximately how much do you think you spent per day on:

Lodging: $________________

Meals: $________________

Boat Tour: $________________

Other expenses: $ ________________

13) Do you consider surfing an ecotourism activity? Why or why not? ___________________

14) What forms of marine recreation are you actively involved in? (circle all that apply)

Surfing Kayaking Fishing Waterskiing Scuba Sailing Other ______________

Background Information

Note: The information you provide is confidential, and will only be used for demographic purposes.

15) Are you: (circle one) Male Female

16) What is your age range? (circle one)

18-25 26-29 30 – 39 40-55 56 – 70 71 or above

17) Do you travel outside the mainland US for the purpose of marine recreation? Y N

18) What is the highest level of education you completed? (circle one)

High School Some College Full College Degree

Some Graduate School Full Graduate Degree Prefer not to answer

19) Which range includes your gross annual income? (circle one)

Under $ 10k $10,000 - $ 29,999 $ 30,000 - $ 59,999 $ 60,000 - $ 89,999

$90,000 - $119,999 $120,000 – $200,000 More than $200,000 Prefer not to answer

20) Other comments ?

____

Thank you very much for taking the time to complete this survey! If you would like to be available for further questions, or if you would like us to share the results of the study with you, please leave your email address below.

This study is sponsored by the Save the Waves Coalition.

<u>Online Survey: Surfing Mavericks</u>

We are looking for feedback regarding your experiences at Mavericks in order to better protect it and other waves throughout the world.

Privacy Statement: No information provided in this survey will be individually attributed to the respondent.

1) Are you at least 18 years old? Y N

2) How many times have you been to Mavericks in the last month? _______

3) Within the last year, how many times have you been to Mavericks?

A. 0-5 times

B. 5-10 times

C. 10-15 times

D. More than 15 times

4) Why do you visit Mavericks? (circle all that apply)

A. To see the waves

B. To watch the surfing

C. To surf

D. To spend time with the surfing community

E. To spend time with family and friends

F. Other: ___________________

4a) Which of the above is the most important reason? A B C D E F

5) What is your zip code? ___________________

6) When you go to Mavericks, do you also patron other services in Half Moon Bay (circle all that apply):

A. Restaurants

B. Shops

C. Accommodations

D. Other ____________________

7) What is surfing to you? (circle all that apply)

A. Recreation/pleasure

B. Exercise/workout

C. Ecotourism

D. Competition/profession

E. Other _____________________

8) What forms of marine recreation are you actively involved in? (circle all that apply)

Surfing Kayaking Fishing Waterskiing Scuba Sailing Other _______________

***The same background information was collected for both the on-site and online surveys.

Appendix II. Template for Evaluating the Economic Benefit of a Surf Contest

This template applies the simpler *Zonal Travel Cost Approach* to estimating the economic benefit of a one-time surfing event. The zonal travel cost method is applied by collecting information on the number of visits to the site from different distances. Because the travel and time costs will increase with distance, this information allows the researcher to calculate the number of visits "purchased" at different "prices." This information is used to construct the demand function for the contest, and estimate the consumer surplus, or economic benefits, for the event.

Step 1: Define zones

The easiest way to define zones is by zip codes surrounding the contest site. This will facilitate the calculation of distance to the site later in the analysis. Determine how far people are likely to travel to the contest, and make a chronological list of those zip codes. Group zip codes into "zones" organized by concentric circles around the contest location.

Step 2: Visitors per zone

The second step is to collect information on the number of visitors from each zone. This is best accomplished by having as many volunteers as possible stand at the entrance of a contest site with the chronological list of those zip codes. They can survey visitors about their zip code, making tick marks by the appropriate zip code to be compiled later. Another option is to have volunteers walk around the contest and collect this information. Be sure that visitors do not respond twice to avoid double counting.

Step 3: Travel cost

Step 3 is to calculate the average round-trip travel distance and travel time to the site for each zone. People in Zone 1 will have the lowest travel cost, with all other zones having increasing travel costs. Next, using average cost per mile, one can calculate the travel cost per trip. A standard cost per mile for operating an automobile is available from AAA or other sources.

Step 4: Regression analysis

The fourth step is to estimate, using regression analysis, the equation that relates the number of event spectators to travel costs and other important variables. From this, one can estimate the demand function for the average visitor/spectator. The analysis might include demographic variables, such as age, income, gender, and education levels, using the average values for each zone. The simplest model includes only travel cost and spectators, i.e., Spectators = Constant – Coefficient*(Travel Cost).

Step 5: Demand equation

The fifth step is to construct the demand function for visits to the contest, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming there is no entry fee for the contest). The other points are found by estimating the number of visitors with different hypothetical entrance fees.

Step 6: Consumer surplus

The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve.

EXHIBIT C

"Who's Counting: An Analysis of Beach Attendance Estimates in Southern California," w. A. McGregor, *Ocean and Coastal Management*, March 2012, Pages 17–25.

"Economic Analysis of Reconfiguring the Long Beach Breakwater," w. A. McGregor, *Shore and Beach*, April/May 2011.

Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria (2002)
http://userwww.sfsu.edu/pgking/carpenteria.pdf

The Economics of Regional Sediment Management in Ventura and Santa Barbara Counties: A Pilot Study, Interim Report To The Coastal Sediment Management Workgroup Prepared by Philip G. King, Ph.D. Economics Dept., San Francisco State University July 2006
http://www.dbw.ca.gov/CSMW/PDF/Economics_of_RSM_0706.pdf

Can California coastal managers plan for sea-level rise in a cost-effective way?
Philip G. King, Aaron R. McGregor & Justin D. Whittet
http://www.tandfonline.com/doi/abs/10.1080/09640568.2014.985291

Full version of paper at:
http://dbw.ca.gov/csmw/PDF/Overcrowding_Demand_%20for_Beaches_in_Southern_California_ver2.pdf

EVALUATION OF EROSION MITIGATION ALTERNATIVES for Southern Monterey Bay Prepared for Monterey Bay Sanctuary Foundation and The Southern Monterey Bay Coastal Erosion Working Group May 30, 2012

http://montereybay.noaa.gov/new/2012/erosion.pdf

An Analysis of the Recreational Benefits due to A Proposed Nourishment Project at Broad Beach, Malibu Prepared by: Dr. Philip G. King September 22, 2013
http://www.slc.ca.gov/Info/Reports/Broad_Beach/Appendix/E-1.pdf

King, P. G. 2005. The Economic and Fiscal Impact of Carlsbad's Beaches: A Survey and Estimate of Attendance. Prepared for the City of Carlsbad's Beach Preservation Committee.

King, P. 2006. "Estimating Beach Attendance and Calibrating the Beach Counters in the City of Encinitas," Prepared for the City of Encinitas, February 2006

EXHIBIT D

Abstract

Accurately assessing the value of California's beaches is critical. Economists have made significant strides in obtaining the socioeconomic data necessary to make these assessments, but official estimates of attendance are typically based on old algorithms from unavailable studies. Moreover agencies often have an incentive to overestimate.

This study assesses attendance estimates at selected beaches in Santa Barbara, Ventura, Los Angeles, Orange and San Diego counties including field data we collected. We conclude that official counts seriously overestimate attendance. In particular, the "turnover factor" applied, is frequently *much* too high. Moreover, this bias is not random but correlated with a number of factors.

Unlike previous studies, this paper also demonstrates the importance of estimating different types of beach recreation, which often have differing attendance patterns and different economic values. Most counts focus on estimating visitors on the sand; we also estimate the attendance patterns of a group often undercounted—surfers.

JEL Category: Q5

Key words: beach, attendance estimates, non-market valuation, California

Introduction

California's coastline is an enormous resource, which drives a significant part of the State's economy, is home to critical habitat such as coastal wetlands, and represents an enormous recreational resource. It is likely that preserving and protecting this coastline over the next decades will become an even more important issue, especially as population increases, sea level rises, and pressure for further development place more stress on an already overloaded and fragile coastline. Protecting the coast and making intelligent decisions about competing uses requires accurate scientific information about the morphology of the coast and how it changes over time as a result of natural and human factors. Geologists, oceanographers, biologists, coastal engineers and many other scientific/engineering disciplines must be brought into the discussion about the coast so the best available science can influence future policy and planning decisions.

Accurate social science is also critical. Over the past fifteen years our knowledge of some types of economic activity on the coast has grown considerably. For example, we have better data on how much people spend at beaches and other coastal sites as a result of studies conducted with federal, state, and local support. We also have reasonable information on the welfare benefits of beach recreation[1] and composition of visitors to many coastal sites.

However, one critical variable is accurate attendance records. Without detailed attendance numbers at beaches or other coastal sites, it is extremely difficult to make reasonable inferences about spending and the overall contribution of these beaches to economic activity. Good attendance data also is essential in assessing mitigation estimates for oil spills (e.g., the *American*

Trader Case), mitigation for seawalls through the California Coastal Commission, and many other environmental and public assessments.

Currently, many southern California coastal agencies collect and archive visitation data computed by lifeguards, parking receipts, or other techniques. However, the reliability of this data is an issue. When asked about their estimates, lifeguards and other officials have a standard mantra—they are following a procedure established decades ago using parameters they cannot justify. For example, in an email, a supervisor at one of the most heavily attended beaches in southern California was asked:

> *"Do you know how the (turnover) method was developed (by who, when)?"*

The response follows:

> *"Sorry, but no…The system was developed long before I started working here; I've been here for more than twenty years. My guess is that it was developed in the 50's or 60's. In the early 2000's, we duplicated the system's formulas in a database but had neither clear definitions nor historical background. This is why we typically only report monthly or yearly totals and don't go too far into details…I'll continue to research the system's history and give you a call/email if I find anything."*

The above example is typical. In the vast majority of cases, there is no available social science research or consulting reports for the methodologies employed to estimate attendance. Every lifeguard we have spoken to has said (not surprisingly) that their first and foremost duty is public safety and in private, off the record, conversations with lifeguards and former lifeguards it becomes very apparent that these attendance counts are considered a low priority and the estimates are often viewed skeptically by the very people collecting the data.

Previous Studies

The literature on assessing attendance at beaches is limited but there are a few papers that have been circulated/published. The most important early paper is an unpublished working paper, "Estimating Use Levels with Periodic Counts," by H. Spencer Banzhaf (1996). Banzhaf's paper provides a comprehensive theoretical treatment on how one should analyze periodic counts—counts done at one or more times during the day of people on the beach at the time--which are typically used in beach counts conducted by lifeguards or an aerial photograph.

Apart from getting an accurate count, the key challenge in this methodology is figuring out how to translate a specific count at one particular time (e.g., noon) into an estimate of how many people actually visited to the beach that day. Banzhaf's analysis also allows for more than one count per day, which is sometimes used.

The key issue in making an estimate, as Banzhaf indicates, is having an accurate estimate of the distribution function of arrival times and departure times (and this function likely changes with the weather, season, day of the week, etc.). Banzhaf's analysis begins with a distribution function which defines an arrival function $\alpha(t)$ and a departure function $\delta(t)$. The net number of people on the beach at any given point is $\alpha(t) - \delta(t)$ which Banzhaf defines as $z(t)$. Figure 1 above depicts one example of such a function, where the bulk of arrivals are in the morning and the bulk of departures are in the afternoon. However Banzhaf's analysis does not depend on the functional form used for arrivals or departures.

Mathematically, the number of people on the beach during a day is just equal to the integral of the arrival function $\alpha(t)$. However, lifeguard counts do not typically observe arrivals, one observes the number of people on the beach at a particular time (arrivals minus departures) $z(t)$.

So estimating total beach counts from a periodic count requires translating a measurement of z(t) at on particular point in time into the integral of $\alpha(t)$.

Banzhaf defines the joint probability density function of arrivals and departures as f(a, d). The probability of a person j being counted at a particular time t is a double integral of the arrival and departure probability density functions follows:

$$P(\, j \in Ci) = \int_{d=t}^{24} \int_{a=0}^{t} f(a, d)\ da,\ dd$$

Where:

P(j∈Ci) is the probability that j is on the beach before time t (aj < t) and departs after time t (dj > t).

Banzhaf develops a system for multiple counts, but since this project focused on official counts, which almost always involve only one count per day, we will simplify his discussion. He defines X_j as the probability that a person will be counted on day j and V_j as the number of visitors per day. Then:

$$E(V_j) = (1/X_j)*C_t$$

Where:

C_t is the count at time t.

In many contexts $1/X_j$ is referred to as the "turnover factor" and is a critical component in many counts, in particular lifeguard counts. Many lifeguard and other agencies use this factor as a constant, but it is important to recognize that it likely varies with time t, often quite significantly. It also may vary with season, type of recreation, day of the week, weather patterns, etc.

Banzhaf applies his analysis to a project at Avila beach, California and uses survey data on the length of people's stays at the beach. Banzhaf makes a number of very strong assumptions about arrival and departure times and using these assumptions he derives an arrival and departure function and estimates the probability that someone is at the beach at a particular period of time.

In a working paper for NOAA, Kristy Wallmo (2003) uses a similar type of analysis as Banzhaf for attendance at Dewey Beach, Delaware. Wallmo uses both periodic counts and "all day counts" which involve using counters at entrances and exits. Her analysis of periodic counts examines different zones and estimates the number of people (arrivals) per day at zone z:

$$A = \sum_{p} \sum_{z}^{Z} \frac{n_{pz}}{f_{pz}} \left(\frac{1}{\bar{d}_p} \right)$$

Where:

A equals the number of daily arrivals in zone z.

n_{pz} is the zone count during time period p

f_{pz} is the zone sampling probability

d is the average trip duration given arrival at time interval p.

To incorporate information on arrival-dependent trip duration and the time of the periodic count, Wallmo segmented the sampling day into *p* segments and estimated trip durations for each segment. Wallmo compares three different techniques for estimating beach attendance: all day counts, periodic counts and flyovers. According to Wallmo, nearly all visitors to Dewey Beach access the 1.2 miles of coastline via one of twenty footpaths distributed along the length of the beach. Wallmo concluded that the three survey techniques produced consistent results, as a

majority of estimates fell within the 95% confidence intervals of each other. Of the three techniques, overflights produced the largest standard errors. In comparing the cost effectiveness of the survey techniques, periodic counts (by humans) proved the most economical at a cost of $600 per day compared to $2,400 for all day counts and $2,700 for overflights.

A significant literature on beach attendance estimates also stems from one legal case, the *American Trader* case. Involving an oil spill of over 400,000 gallons of crude oil off the coast of Huntington Beach, California. Oil deposits, both at sea and onshore, resulted in the closure of 14 miles of beach for over five weeks. To calculate the economic damages of the oil spill, Chapman, Hanemann, Ruud modeled attendance levels where beach closure occurred. Due to a limited budget, these studies did not collect any original data.

Working for the State, Chapman and Hanemann (2001) used a vector-autoregressive (VAR) model to predict the daily attendance that would have occurred if not for the oil spill. A benefits transfer model was applied to estimate the loss of consumers' surplus based on the number of trips, thereby converting the predicted loss of recreational trips to dollar values. To review these findings, the defendants, Golden West Refinery and ATTRANSCO, contracted Deacon and Kolstad (2000) who challenged Chapman and Hanemann estimation of lost trips and consumers' surplus. Deacon and Kolstad also questioned the official data collection methods used by Chapman and Hanemann.

To estimate attendance, Deacon and Kolstad used aerial photographs in conjunction with survey data. Survey responses were used to produce an estimate of mean visit duration and subsequently interpolated to estimate the total number of daily visitors. Deacon and Kolstad compared their estimates of total daily attendance (at each of the affected areas) to official agency estimates. Estimates interpolated from aerial photographs and field surveying were

significantly less than those reported by the coastal agencies - highlighted by lifeguard counts overstating the actual attendance by a factor of 3 on a Friday in February 1995 and by a factor of 5 on the following Saturday. Questioning Deacon and Kolstad's methods, Chapman and Hanemann compared their estimates to official agency estimates. Over the duration of the 5-week period, the attendance estimates reported by the official agencies (for the five affected beaches) exceeded Chapman and Hanemann's estimates by 9.4% (Chapman et. al 2001).

By comparing estimates, Chapman and Hanemann identified unambiguous patterns in reporting errors. Often, lifeguard scheduling hours do not correspond to the full spectrum of time when visitors are at the beach. Chapman and Hanemann identified lifeguards' failure to account for early morning and late afternoon visitors as encouraging inaccurate results. Another observed trend involved lifeguards understating attendance on days with low attendance and overstating attendance on days with large crowds. Additionally, at State beaches, where a different collection methodology was used to that of municipal beaches, there were fewer people per vehicle than the listed conversion factors, but a higher ratio of walk-ons to drive-ins than assumed.

Since the American Trader case, few studies of beach attendance have been conducted. King (2005, 2006) estimated beach attendance for the Cities of Carlsbad and Encinitas in north San Diego County. In Carlsbad, periodic counts were taken at eight different reaches, similar to Wallmo's (2003) zones. King also surveyed visitors in order to estimate arrival and departure patterns and generate a frequency distribution similar to that described in Banzhaf and Wallmo above. Using the survey and resulting frequency distribution of arrivals and departures, King developed a methodology for estimating total attendance in a day.

King concluded that while the general methodology employed by State Parks seemed sound, the factors used to estimate the model needed to be recalibrated. He provided a suggested methodology that incorporates the number of cars, people per car, people not going by car, cars not counted, and turnover factor to estimate attendance. King's methodology yielded attendance estimates that were about two-thirds of the official counts.

In another paper, King (2006) examined the use of electronic counters in Encinitas California, just south of Carlsbad. In 2001, the City of Encinitas stopped collecting attendance data due to the lack of consensus on existing collection methodology along its 6.2 miles of beach. Encinitas is similar to Dewey Beach, Delaware, described above by Wallmo, in that most of its beaches have limited access points. Typically a visitor must walk down a steep set of stairs from a bluff overlooking the beach. These limited access points are ideal for laser counters.

King examined five access points and compared the laser counts to periodic counts made on the same day. King also compared human counts of people passing through access points at certain intervals compared to the laser counts. With a couple of notable exceptions, King concluded that the counters did well. At three spots, the counters slightly undercount people going through the access point. At two other spots, there was a tendency to over count. The most significant problem was at Moonlight Beach, where the lack of counters at two key access points led to a serious undercount.

Techniques Used for Estimating Attendance at California's Beaches

California coastal agencies use a variety of techniques to estimate beach attendance. The most commonly used methods include: lifeguard counts of patrons on the beach and parking counts. Lifeguard counts are generally performed by two distinct methods:

1. At periodic times during the day, lifeguards will estimate the number of visitors in a defined zone and, in some cases, multiply this total by a turnover factor to calculate the daily attendance.
2. At the end of the day lifeguards will estimate the total number of people on the beach, often with the assistance of look-up tables that provide general high and low attendance estimates for days of the week (weekday v. weekend) corresponding to season or months of the year.

The accuracy of lifeguard counts in California has not been studied in detail beyond a few beaches in the *American Trader* case and Dr. King's studies in Carlsbad. Chapman and Hanemann's use of all day counts to compare lifeguard counts (at beaches affected by the oil spill) produced ambiguous results and Deacon and Kolstad as well as King later, indicated that lifeguard counts tended to be too high.

Many coastal agencies measure attendance by monitoring parking areas adjacent to access points. Because parking at beaches is generally near a few access points, coastal agencies can identify the total number of cars "using" a particular beach by (1) tallying parking receipts (where applicable) and/or (2) estimating the daily turnover to midday car counts. Parking counts also include an estimate of the number of people per car. On their own, parking estimates fail to account for visitors who access the beach by walking or alternative means of transportation or from unmonitored access points. Therefore accurate parking estimates should also include a ratio of walk-ins to vehicles.

Attendance Collection Methods Used at Beaches in the Study Sample

A total of 46 beaches were examined in this study. Periodic counts and sub-sampling require significantly more time and resources at beaches that are both long and wide. Therefore, covering a majority of beaches in both Los Angeles County and Orange County was considered infeasible. From the 46-beach sample, approximately 83% of the sites were managed by either a state, county, or municipal agency. The remaining 17% of beaches had no agency oversight or defined amenities (e.g., dedicated parking, restrooms, lifeguards). Municipalities were the most common administrative agency followed by California State Parks, county agency, and no agency.

Almost all of the agencies administering beaches in our sample record some form of attendance estimates. Approximately 90% of administered beaches log attendance estimates daily, quasi-daily, monthly, seasonally or annually. The most common attendance collection frequently was daily followed by never, monthly and annual, quasi-daily, and seasonal, respectively.

A myriad of attendance collection techniques are used by agencies in our study sample (see Table 1 below). The primary collection techniques fall under seven main categories: (1) lifeguard visitor counts; (2) lifeguard lookup table; (3) camping receipts; (4) parking lot receipts; (5) parking lot counters; (6) street parking; and (7) electric counters. Agencies can, and should, use more than one of these techniques to approximate attendance. Approximately one-third of agencies within the study area employ two or more of these techniques to estimate attendance. Parking lot receipts were the most commonly used technique followed by lifeguard visitor counts, camping receipts, street parking, lifeguard lookup tables and electronic counters, respectively.

Study Methodology

Our approach to estimating the total number of people on the beach on a given day was to use one periodic count. As discussed earlier, particularly form Banzhaf (1996) and Wallmo (2003), determining the total number of people who go to a particular beach on one day requires that one know the frequency distribution of arrivals and departures throughout the day or that one make some quite restrictive assumptions. The easiest approach is to use the mean visit time and assume that everyone follows this mean. The problem with this approach is that the arrival time and duration of stay are generally not independent. People who arrive earlier tend to stay longer. To account for this fact, we surveyed visitors throughout the day, weighting the number of surveys at a particular time to the density of visitors on the beach. The surveys were quite short and only asked about arrival time, departure time, number of people in the group and recreational activity.

Our surveys, interviews, and observations also indicate that there are at least four distinct groups of activities that have substantially different arrival and departure activities:

1. Sand activities other than walking including light swimming in the water, especially by children
2. Surfing
3. Walking on the beach
4. Other beach activities on the sand, pier and near shore.[2]

The arrival and departure frequencies also vary significantly at different beaches depending upon a number of factors—whether campers make up a significant portion of visitors, the weather,

(e.g., in Santa Barbara and Ventura Counties the beaches are often quite cool until late morning) and possibly other factors. After examining the data, we pooled beaches in the following groups:

1. **Channel Coast Beaches with Camping**: Gaviota State Beach, El Capitan State, Refugio State Beach, Carpinteria State Beach, and Emma Wood State Beach.

2. **Channel Coast (non camping) Beaches** including relatively wide, sandy beaches defined by sand based recreation: Arroyo Burro County Beach, Leadbetter Beach, West Beach, East Beach, Butterfly Beach, Lookout County Park, Carpinteria City Beach, San Buenaventura State Beach, Ventura City Beach, and Silverstrand Beach.

3. **Channel Coast Surfing Beaches** includes narrow beaches, many of which disappear at high tide, primarily used for recreational surfing: Santa Claus Beach, Rincon Point, La Conchita, Mussel Shoals, Hobson County Park, Faria County Park, Mondos, Rincon Parkway North, Rincon Parkway South, and C-Street.

4. **Los Angeles County Beaches** are generally wider and cater to both sand and water recreation. Attendance counts were collected at Mother's Beach, Hermosa Beach, and Manhattan Beach.

5. **Orange County Beaches** are generally expansive sandy beaches, varying in length, accessible from multiple entrance points and utilized for both sand and water recreation. Attendance counts were collected at: Newport Beach, Corona Del Mar State Beach, Crystal Cove State Beach and Doheney State Beach.

6. **N. San Diego County Beaches** includes narrow beaches, many of which disappear at high tide, are used for leisure, bathing and recreational surfing. Attendance counts were

collected at San Elijo State Beach, Cardiff State Beach, Moonlight State Beach, Swami's, Del Mar Beach, and Torrey Pines State Beach.[3]

7. **S. San Diego County Beaches** are generally expansive sandy beaches. Attendance counts were collected at La Jolla Shores, Pacific Beach, Mission Beach, Coronado Beach, and Imperial Beach.

Tables 2 below summarizes the results of our surveys broken down by the beach groupings described above.[4]

Technique Used To Estimate Attendance

Our general approach follows Banzhaf and Wallmo discussed above. However, as our study progressed we soon realized that the arrival and departure times also vary considerable depending upon the type of activity, something that Wallmo and Banzhaf did not explicitly account for. Consequently, in this paper, we use a notation similar to Banzhaf, but extend the analysis to account for multiple activities (i = 1…n). Following Banzhaf's notation we define an arrival function $\alpha_i(t_j)$ and a departure function $\delta_i(t_j)$.

Therefore, let:

$\alpha_i(t_j)$ = Probability that someone engaged in activity i arrives during time period j.

$\delta_i(t_j)$ = Probability that someone engaged in activity i departs during time period j.

$z_i(t_j) = \alpha_i((t_j) - \delta_i(t_j)$ = Probability that someone is on the beach during time period j.

Where:

i = 1…m, j = 1…n.

Thus at any given time t_i, the probability that someone is on the beach is $z(t_i)$. The "turnover factor" is simply the inverse of $z(t_i)$ or $1/z(t_i)$. As an example suppose that one counts 1000 people on a beach at noon and the probability of someone being on the beach at that time is 1/3. The turnover factor is 1/(1/3) or just 3 and one's estimate of the total number of people on the beach at a given time is 1000*3= 3000.

Table 3 below presents the turnover factors for each of these beach groupings. The turnover factors are much higher in the morning since fewer people are on the beach in the morning and thus the probability of observing someone during that time is lower. As a practical matter, counts should be made during the middle of the day when the most people are on the beach and the turnover factor is lowest. Using counts during non-peak times increases the noisiness of the estimates and thus the likelihood of getting poor results.

The lowest turnover factors were generally between 1pm and 2pm, but at some beaches the turnover factors between 2pm and 3pm were slightly lower. Most lifeguard counts occur between noon and one which is a reasonable time, but our data indicates that conducting these counts slightly later in the day would probably make more sense.

To account for surfers distinct arrival, departure and visit duration, which influences the probability of being accounted for in a periodic count, a data set on surfing was secured from Chad Nelsen, a Ph.D. candidate in Environmental Science and Engineering at the University of California, Los Angeles. Mr. Nelsen carried out an internet-based survey to identify the demographic, visitation and expenditure patterns of surfers who visit 22 of California's most popular surf sites. Data on the arrival and departure time of survey participants was extracted and used to calculate a surfing-specific turnover factor in the same manner as the method outlined above.

Analysis of the surfing data supports the belief that surfers have different arrival, departure and visit durations. Figure 2 below illustrates that the frequency of arrival time for surfers and beach-goers in our sample differed greatly. Peak arrival time for surfers is between 6am to 8am whereas peak arrival time for beach-goers was from 11am to 12pm. Departure times for surfers and beach-goers were also very different. Peak departure times for surfers fell between 9am and 11am whereas peak departure time for beach-goers fell between 4pm and 6pm.

The variance in arrival time and departure time for surfers v. the majority of beach-goers validates the use of a separate turnover factor for the two groups. The discussion below clarifies how separate turnover factors were applied to daily periodic counts to estimate total daily attendance loads.

Estimating Total Daily Attendance

To produce daily attendance estimates for beaches in our sample, the respective turnover factors calculated from sub-sampling surveys and the supplemental surfing dataset were applied to periodic day counts. Generally, counts were conducted at peak attendance times between the late morning and early afternoon. For each beach, the study attendance counts were broken down into recreational activity (e.g., swimming, surfing, walking, etc.). For the final estimates, we used two categories: (1) all sand and bathing activities and (2) surfing: These sub-categories were multiplied by respective turnover factors to estimate total daily attendance.

Our daily attendance estimates were compared with official daily counts by calculating daily attendance ratios of our estimates divided by official agency counts. An initial evaluation of the daily attendance ratios revealed large discrepancies between are estimates and official counts. The common trend was for official agency counts to be significantly higher than our estimates, in

some cases by a factor of more than 5. Respective agencies were contacted to ensure that our estimates accounted for the entire coverage of beach used to project official agency count.

Conversations with official agency staff made it evident that our periodic counts did not capture the entire population of beach-goers that are incorporated in official agency counts. Specifically, a large number of beaches in the study area contain boardwalks that are used for walking, jogging, cycling, rollerblading, and skateboarding. Additionally, shops and restaurants lie adjacent to multiple beaches in the study area. Patrons of these establishments often venture onto the boardwalk and/or the fringe of these beaches. Because of the difficulty of counting and intercepting individuals who use the boardwalk and patrons on the outer boundary of the beach, we deemed it infeasible and unreliable to include these individuals in our counts from the start.

Data from the Southern California Beach Valuation Project (SCBVP), a multi-year study evaluating potential substitution to beach attendance from changes in water quality, was used to address our potential undercounting of individuals that shop, dine and recreate on or near boardwalks.[5] Based on the SCBVP activity data, it was estimated that on average our estimates did not account for 25% of the beach population on any given day. As a result, we increased our daily estimates by 25% to ensure that study estimates were comparing similar populations of visitors as official agency counts.

There were sufficient official daily attendance counts from twenty-four of the beaches in the five county study area. Table 4 below provides the average ratio for each beach where study estimates and official agency counts were available. The range of results spanned anywhere from 0.19 to 6.22, indicating that in some cases official agency counts were 5 times higher to 6 times lower than our estimates. However, the most common trend was for official agency counts to be

larger than our estimates. Only 4 of the 24 official agencies recorded average daily attendance counts higher than our own.

Examples for Over and Under Counting

Carlsbad, in north San Diego County, had the lowest attendance ratio of 0.18, indicating their counts were over 5 times higher than ours. Carlsbad officials count the number of free and paid vehicles at midday when attendance levels are near their peak. To calculate daily attendance, they take vehicle load totals and apply it to a person per vehicle turnover ranging from 1.7 to 2.1. Then, they multiply this value by a turnover factor of 12-14 to account for vehicle turnover and beach-goers that access the beach by alternative modes. The person per vehicle turnover is likely conservative and could probably be increased. However, the turnover factor is much too high. Our survey data indicates the average beach visitor stays for approximately 4 hours, thus a turnover factor of 14 results in significant overcounting.

High vehicle turnover factors can also result in overcounting, especially when they are applied to vehicles and persons that may not be using the beach, such as at Goleta beach, just north of Santa Barbara and adjacent to UC Santa Barbara. Almost all visitors at Goleta beach access the beach via the parking lot. A parking lot counter captures cars entering the beach parking lot. The counters are not examined daily or even monthly. Rather, at the end of each year the counter is read to produce an annual count of cars that is applied to a 2.5 person per vehicle turnover.

Because Goleta beach did not have official daily counts for comparison, we analyzed their 2007-2008 annual count of 1.6 million visitors. Goleta beach would need to host over 4,400 visitors per day to reach their annual projection. Accounting for the fact that almost 50% of beach attendance is on Saturday and Sunday (Dwight et al. 2007)[6], there would need to be

approximately 7,450 persons visiting Goleta beach on any given weekend day during the year. Recognizing that nearly 54% of annual beach attendance in southern California occurs in June, July and August (Dwight et al. 2007), per day weekend visitation would need to be on average of 16,000. To host 16,000 visitors at 2.5 persons per vehicle, Goleta would need to provide parking for 6,400 vehicles per weekend day in the summer months. Considering that Goleta provides only 550 number of parking spots, there would need to be a average daily parking spot turnover of greater than 11.5. According to our survey data, visitors at beaches similar to Goleta in Santa Barbara County and Ventura County visit the beach for approximately 3.5 hours. It follows that it is highly improbable that each parking space at Goleta hosts 11.5 cars per day. Further, the largest daily estimate of attendance at Goleta beach in our study was approximately 1,850 persons, almost an order of magnitude lower than the required per day weekend value in June, July and August of 16,000.

It was not difficult to identify the primary reason for overcounting at Goleta beach. It is common knowledge that students at UC Santa Barbara use the parking lot at Goleta beach. Because Goleta projects annual attendance solely with vehicle counts and subsequent person per vehicle turnovers, they were including a large population (university students) of parking users who were not going to the beach. This was further supported by multiple site visits that captured over 300 cars in the parking lot with less than 100 total persons on the beach, pier, park or shorefront restaurant. Goleta beach is a primary example of overcounting from the inclusion of non-beach patrons in beach counts.

Our results are also consistent with a recent study conducted for the City of Solana Beach (2010). Although Solana beach stopped taking official estimates many years ago, the unofficial estimate given frequently by local officials (and used by other agencies, for example, the US

Army Corps of Engineers) is much higher than estimates based on actual counts or even casual interviews with local lifeguards.

As discussed above, daily official agency counts at a few beaches were larger than ours. This was highlighted by San Buenaventura State Beach that had an average daily attendance ratio of six. Identifying the undercounting at this beach was quite simple. Officials at this site use turnover values for free vehicles, paid vehicles and camping (which is non-existent). Examination of official agency data revealed extremely low free vehicle counts (street parking), the highest topping out slightly above 100 vehicles. San Buenaventura beach is approximately two miles long. While there is official lot parking, a majority of beach-goers utilize street parking along the entire reach of the beach. It follows that inaccurately recording the number of free vehicles will result in a significant undercount of visitors.

Another example for undercounting is evident at Carpinteria City beach. The average attendance ratio for Carpinteria City beach was 1.5, indicating that our daily estimates were on average 1.5 times greater than official daily counts. Carpinteria City projects daily attendance by requiring their lifeguards to estimate the total number of people on the beach near midday. These periodic estimates are not applied to a turnover factor in a similar method to our periodic estimates. Rather, they are logged as daily total attendance loads. During the time period lifeguards would make their estimates at Carpinteria City beach, our turnover factor ranged from 1.73 to 1.26. The average of these turnover factors is approximately 1.5, supporting the undercounting ratio at this site.

Econometric Analysis of Differences in Counts

Where official data was available in daily counts, we were able to match our estimated counts for the same day and compare the two counts. As table 4 shows, our counts were generally lower than the official counts, but not always. However we were also interested in the question of systematic errors. For example, we heard anecdotal evidence that lifeguard counts tended to be much higher than the actual count on slower days while this ratio was lower on busy days. We were also interested in whether different agencies or different counting methodologies (e.g., lifeguard counts versus parking counts) lead to systematic differences.

In order to tests these hypotheses we used standard econometric techniques. The data was imported from Excel into *Stata* and we ran the following regression. We pooled the data from all of our beach observations. However, many agencies only provided us with monthly data; our analysis below required daily data. First we created the following variables:

For the dependent variable we used the ratio of the official count on a given day to our count for the same day at the same beach:

Ratio = our daily estimate/official daily estimate

For the independent side of the equation, we used a number of different variables:

- For each individual beach, we wanted a measure of how busy a particular day was compared to an average day. We defined:

  Busyness = our daily estimate at a particular beach divided by the mean of all our estimates at that particular beach

- **Mean temperature** measured the average temperature during that particular day.
- **Mean wind** measured the average wind speed during that particular day.

- **Lifeguard Count** is a dummy variable indicating whether a lifeguard count was used or not.
- **Parking Count** is a dummy variable indicating whether a parking count was used or not.[7]
- **State Agency** is a dummy variable indicating whether the count was conducted for a State Agency—in all cases this was California State Parks.
- **City Agency** is a dummy variable indicating whether the count was conducted by a City Agency.
- **Day** was a dummy variable for day of the week: weekday (Monday through Friday) or weekend (Saturday/Sunday).
- **Length** of beach measures the length of the beach in feet[8]

We initially ran all of these variables in a standard linear form, however the distribution of the error terms was heavily skewed. We used the log for all continuous variables to ensure that our error terms were no longer skewed. The results of our analysis are presented below, limited to the presentation of variables that were significant. Our approach is also consistent with Train (1998) who uses log transformations for beach size in a slightly different context (beach choice).

Linear regression: logratio; logbusyness logmeantemp logmeanwind lifeguardcount parkingcount day loglength cityagency, robust[9]

Our results (Table 5 above) generally confirm our initial hypotheses. The logbusyness sign is negative and highly significant, indicating that on days when beach attendance is high relative to the mean, the (log of the) ratio of our counts to official counts was lower than on slower days. This confirms what we have heard anecdotally. There are several possible explanations. First, lifeguards (especially when using a lookup table) tend to have a standard count regardless of actual attendance. We also observed that when attendance was based on local parking counts, cars parked by people not going to the beach were often included, which would also explain this bias. Since government agencies often receive funding based on reported attendance, the incentive to report slow days accurately is low.

The logmeantemp was positive and significant although the coefficient is small, indicating that on warmer days the ratio of our estimate to the official estimate was higher. We believe the issue here involves endogeneity in the turnover factor, which a more sophisticated model would have accounted for. On warmer days the turnover factor should be slightly higher since the effective length of a beach day is longer—in southern California warmer days are generally associated with the "june gloom" fog burning off sooner in the morning and warmer in late afternoons. Similarly, the logmeanwind variable was negative and significant although the coefficient is small, indicating that on windier days our turnover factor should be somewhat lower. Once again, windier days typically imply a shorter period for people to recreate. Often the wind will pick up in mid afternoon and many people will leave the beach in a short period of time.

The lifeguard count variable was positive and significant indicating that where lifeguard counts were used, the ratio of our counts to the official counts was higher. Since the vast majority of the ratios were less than one (indicating that official counts are too high) having a positive

coefficient on lifeguard counts indicates that lifeguards did a better job than others, on average. We had a similar result for parking with an even higher coefficient which was even more significant. Once again parking counts did better than other types of counts.

We also included two variables for type of agency, state (typically State Parks) and city (for beaches run by a local city[1]).[10] The coefficient for State agency was negative (indicating that State agencies tend to overcount more) but insignificant. For cities, the coefficient was positive and significant, indicating cities counts were closer to ours than others.

Our dummy variable for day was significant and positive, implying that the ratios were slightly higher on weekends (when the dummy was one). Once again, we believe this has to do with the turnover factor, which should be slightly higher on weekends.

Finally, the variable length, which measures the (log)length of the beach was positive and significant, indicating that longer beaches had very slightly higher ratios (more accurate counts). This result could be considered counterintuitive, since one could argue that counts should be more accurate at smaller beaches. On the other hand, if one considers a public choice model where beaches are given funds based on official attendance estimates, it may make sense for smaller beaches tend to have higher overcounts than larger ones since high attendance counts are an important factor in receiving funding. At the larger California beaches attendance counts are already very high and thus there is a lower incentive to overcount.

We also ran a more elaborate regression analysis incorporating the turnover factor used by various agencies and whether parking counts were used (and if so, what type—street or official—or both). Our hypothesis here is simple—higher turnover factors should, *ceteris*

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paribus, lead to higher overcounting (and hence a higher ratio compared to our counts). We would also expect that counts that rely on street parking (or official parking when the lot serves both beach visitors and other visitors) would tend to be higher since, as noted above, these counts often include people not going to the beach.

As above, for the dependent variable we used the ratio of the official count on a given day to our count for the same day at the same beach:

Ratio = our daily estimate/official daily estimate

For the independent side of the equation, we used a number of different variables:

- For each individual beach, we wanted a measure of how busy a particular day was compared to an average day. We defined:

  Busyness = our daily estimate at a particular beach divided by the mean of all our estimates at that particular beach

- **Beach Turnover** was the turnover factor agencies apply to patrons on the beach at a periodic time in the day
- **Lot Vehicle** was the person per vehicle factor applied by to vehicles in official agency lots
- **Street Vehicle** was the person per vehicle factor applied to vehicles in unofficial (street) parking areas
- **Day** was a dummy variable for day of the week: weekday (Monday through Friday) or weekend (Saturday/Sunday).

- **Season** was a dummy variable indicating what season comparative attendance counts were made: low season (Labor Day to Memorial Day); high season (Memorial Day to end of June, August 16^{th} to Labor Day); very high season (July 1^{st} to August 15^{th})

We ran the regression using the log form for all continuous variables to ensure that our error terms were no longer skewed. The results of our analysis are presented below.

Linear regression: logratio; logbusyness beachturnover lotvehicle logstreetvehicle day season, robust

Our results (Table 6) are consistent with our initial hypotheses. The coefficient for turnover factor is highly significant and indicates that agencies using larger turnover factor had substantially higher overcounts. Clearly turnover factors need to be examined carefully if the official estimates made by government agencies are to be credible. Our analysis also indicates that, *ceteris paribus*, the use of a parking count methodology leads to higher overcounts. As we hypothesized, this is likely due to the fact that parking counts often count visitors (cars) who do not go to the beach, whereas lifeguard counts should only count people on the beach. One slightly puzzling result is that our coefficient for lot counts was higher than street counts, which is counterintuitive. We believe this is likely due to gross overcounts at a couple of official lots like Goleta and larger person per vehicle factors for lot vehicles versus street vehicles.

Conclusion and Policy Recommendations

Our main conclusion is quite clear—the official counts used for public policy in the State of California have a strong upward bias—that is, they tend to overcount the actual number of people who are on the beach. The biggest culprit we have found is not the actual counts or the diligence of the people doing the counts, but rather the methodology used to estimate the final

attendance numbers, in particular the turnover factor typically used is far higher than it should be. Our own surveys indicate that if one has an accurate count of the people on the beach in early afternoon (1 pm or 2 pm is better than the traditional noon count) the turnover factor applied is actually quite low. However these counts will not accurately count surfers or walkers who have very different visitation patterns both in terms of daily activity (surfers and walkers peak early in the morning and in late afternoon/early evening) and seasonality (surfing and walking are much less seasonal). In the case of surfers, especially serious surfers, wave activity is a significant determinant of beach visitation as well. There is also difficulty in accurately capturing people on the boardwalk and sightseers on the fringe of the beach. Lastly, it is imperative the beach counts are just that— counts of individuals who are visiting the beach rather than counts of individuals who park near the beach for other purposes.

Unfortunately our results cast serious doubt on the meaningful use of official data for use in policy and socioeconomic applications. Attendance data is used to estimate the welfare losses due to beach closures, the economic impact of beach spending, the benefits of beach nourishment, etc. Without accurate estimates of the true number of people on the beach, these estimates will be far less reliable.

In particular, our analysis indicates that the turnover factors used in these methodologies are far too high and should be reduced. Our analysis also indicates that the use of parking counts is also biased, probably because many people parking do not actually use the beach and some agencies person per vehicle factors are too high.

Our study also indicates the importance of estimating breaking down attendance into different types of activities. The key here is which activities tend to be clustered together in terms of attendance patterns so that on can count at the appropriate time and apply turnover factors in the

appropriate way. It is clear that surfing is an activity with only a weak correlation to more traditional sand activities. We expect that other activities like walking would be similarly less correlated. Pavement and pier activities should be more highly correlated with beach sand activities, but we did not investigate this connection.

The other reason for a more detailed breakdown by type of activity is that the spending, welfare impacts and substitution possibilities vary significantly depending upon the type of activity. People who frequently walk on a beach may (or may not) have more possibilities for substitution, compared to other users. Similarly the set of beaches that sand users would consider good substitutes may be completely different from the beaches that surfers would consider good substitutes.

When beaches are closed due to poor water quality, the type of activity is also important. Clearly people who go into the water are more impacted than people who don't. (Though technically no one is supposed to go to closed beaches in California, in practice many ignore beach closure signs and go anyway.) Consequently it may make sense to weigh water users more heavily in this type of analysis. Spending and estimates of welfare benefits also vary by type of user. Surfing is generally considered to be a more highly values activity in terms of willingness to pay, but surfers typically spend less locally than many other beach users.

Unfortunately, collecting accurate attendance data has never been considered an important activity for policy makers even though a huge number of decisions are made based on estimates that may not be accurate. If this paper has any impact, we hope that it will encourage policy makers to take this issue more seriously and ensure that counts use the best available techniques and methodology. This need not cost more money or take more time, but more attention should be paid to the accuracy of all this data which is so important to sustaining California's coastal

economy and ecology. Based on our analysis and review of prior analyses, we believe that using video technology to record daily periodic counts and sub-sampling techniques to estimate turnover factors is a most cost-effective and unbiased approach to accurately capturing attendance patterns for all types of beach users at a majority of California's beaches.

However, future work in this area should also focus on techniques, which generate more "objective" data such as video counts or electronic counters. Electronic counters only work at beaches with a few narrow access points (e.g., many beaches in Encinitas where they have been used). In contrast, video counts using computer software are likely to be the future preferred technique for counting and these counts are already being used extensively in Australia and have been applied in Hawaii. Video counts have the added benefit that the video typically has other uses (e.g., monitoring shoreline, monitoring biological activity) and thus can be supported by multiple sources of funding. Since the video can be archived digitally, older estimates can be potentially improved as techniques improve. As our study indicates however, any count requires a careful analysis of potential biases and any periodic count requires a detailed analysis of turnover.

It is also important to recognize that attendance patterns and turnover vary by type of recreational activity. This study had provided a detailed analysis of two groups, traditional beach users who lie on the sand and do light swimming and surfers. However a number of other users benefit from beaches, walkers (who typically walk in the morning), folks on the boardwalk or nearby and folks on the pier (where relevant), people who fish and engage in other activities. The attendance patterns of some of these visitors may be very similar (e.g., boardwalk people and sand people in particular are likely to have similar patterns) but this needs to be examined.

References

Banzhaf, S. H. 1996. Estimating Recreational Use Levels with Periodic Counts. Working Paper T-9602. Duke University. Triangle Economic Research.

Chapman, D. J. and M. W. Hanemann. 2001. Environmental Damages in Court: The American Trader Case. In: *The Law and Economics of the Environment*, edited by Anthony Heyes. Massachusetts: Edward Elgar.

City of Solana Beach. 2010, Draft Land Lease/Recreation Fee Study, prepared for the by CIC Research, May 2010, available at: http://www.ci.solana-beach.ca.us/newsmanager/templates/?a=61&z=1

Dwight, R. H., M. V. Brinks, G. Sharavana Kumar, and J. C. Semenza. 2007. Beach Attendance and Bathing Rates for Southern California Beaches. *Journal of Ocean and Coastal Management* 50: 847-858.

Deacon, R., and C. Kolstad. 2000. Valuing Beach Recreation Lost In Environmental Accidents. *Journal of Water Resources Planning and Management* 126(6): 374-381.

Dwyer, J. F., 1988. Predicting Daily Use of Urban Forest Recreation Sites. *Journal of Landscape and Urban Planning* 15: 127-138.

Green, S., M. Blummenstein, M. Browne and R. Tomlinson. The Detection and Quantification of Persons in Cluttered Beach Scenes Using Neural Network-Based Classification. *School of Information and Communication Technology, Griffith Center for Coastal Management*.

Hanemann, M., L. Pendleton, and C. Mohn. 2005. Welfare Estimated for Five Scenarios of Water Quality Change in Southern California. A Report from the Southern California Beach Valuation Project.

Kildow, J. and C. Colgan. 2005. California's Ocean Economy. Prepared for California Resources Agency.

King, P. G. 2005. The Economic and Fiscal Impact of Carlsbad's Beaches: A Survey and Estimate of Attendance. Prepared for the City of Carlsbad's Beach Preservation Committee.

King, P. 2006. "Estimating Beach Attendance and Calibrating the Beach Counters in the City of Encinitas," Prepared for the City of Encinitas, February 2006

King, P. and D. Symes. 2004. Potential Loss in GNP and GSP from a Failure to Maintain California's Beaches. Prepared for the California Department of Boating and Waterways.

McPhail, C, D. Schweingruber and N. Bern. 1997. *The Collective Action Observation Primer, 3rd edition*, Urbana, IL: Department of Sociology, University of Illinois at Urbana-Champaign.

Pendleton, Linwood. A Database of Beach Attendance for Southern California. (Unpublished).

Summary Report on Beach Activity by Wave: A Report on Data Collected from the Southern California Beach Valuation Project. 2001. Prepared by the Research Team for the Beach Project Funders.

Train, Kenneth E. 1998. "Recreation Demand Models with Taste Differences over People." *Land Economics* 74(2): 230–239.

Wallmo, Kristy. 2003. Assessment of Techniques for Estimating Beach Attendance. Prepared for the Damage Assessment Center; National Oceanic and Atmospheric Administration.

[1] For example, see Hanemann, M., L. Pendleton, and C. Mohn. 2005. Welfare Estimated for Five Scenarios of

Water Quality Change in Southern California. A Report from the Southern California Beach Valuation Project.

[2] Our study did not include people on piers, however in some cases people involved in activities near the beach were included (e.g., picnickers at Goleta).

[3] Although Torrey Pines is technically in the City of San Diego its visitation patterns fit more closely with N. San Diego County Beaches.

[4] Survey participants were not limited to selecting the primary activity they would be participating in. Rather, because questions were directed at capturing group characteristics, survey participants were asked to mark all of the activities they would be participating in throughout the day.

[5] Summary Report on Beach Activity by Wave: A Report on Data Collected from the Southern California Beach Valuation Project. 2001. Prepared by the Research Team for the Beach Project Funders.

[6] Dwight, R. H., M. V. Brinks, G. SharavanaKumar, and J. C. Semenza. 2007. Beach Attendance and Bathing Rates for Southern California Beaches. *Journal of Ocean and Coastal Management* 50: 847-858.

[7] Note parking count and lifeguard count are not mutually exclusive since lifeguards often do parking counts.

[8] We also ran regressions with beach width but the variable was insignificant. Area was significant but less so than length and since length and area are dependent we decided to keep length.

[9] Significance was defined as: 99%***; 95%**; and 90%*

[10] The other agencies typically responsible for maintaining beaches are counties. A variable for County could not be used due to multicollinearity.

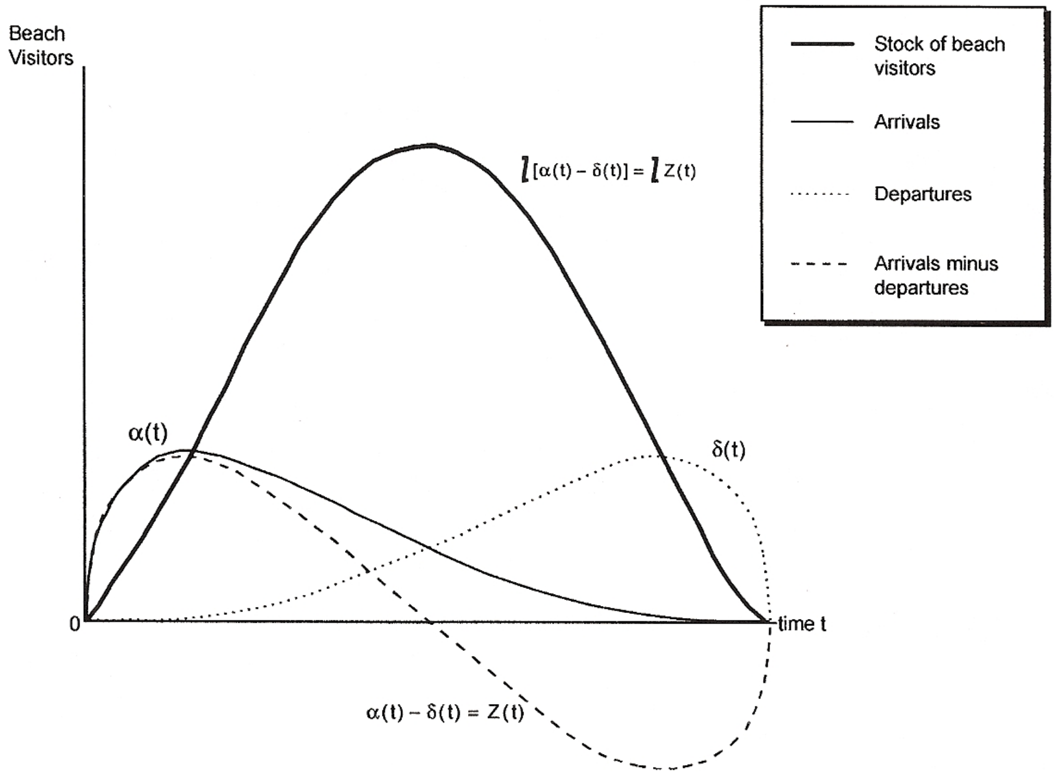

Figure 1: Beach Arrival and Departure Distribution (Banzhaf 1996)

Table 1: Attendance collection technique by County

	Lifeguard Visitor Count	Lifeguard Lookup Table	Camping Receipts	Parking Lot Receipts	Parking Lot Counter	Street Parking	Electronic Counter
Santa Barbara County	3	-	4	4	4	1	-
Ventura County	-	-	5	2	-	-	-
Los Angeles County	-	3	-	-	-	-	-
Orange County	1	1	1	3	-	2	-
San Diego County	6	-	-	3	-	3	1
Total	**10**	**4**	**10**	**12**	**4**	**6**	**1**

Table 2: Frequency of activities per group

Activity	Channel Coast Camping	Channel Coast Beach	Channel Coast Surfing	Los Angeles County	Orange County	N. San Diego County	S. San Diego County
Swimming	17%	25%	2%	23%	68%	68%	63%
Children can Play	68%	61%	31%	0%	50%	50%	37%
Surfing	3%	2%	61%	28%	30%	30%	16%
Walking	10%	5%	8%	0%	58%	58%	29%
Hanging Out	87%	89%	47%	69%	79%	79%	86%
Other	13%	9%	6%	3%	39%	39%	21%

Table 3: Turnover factor for beach groupings in the 5-county study area

Multiplier Time	Channel Coast Camping	Channel Coast Beach	Channel Coast Surfing	Los Angeles County	Orange County	N. San Diego County	S. San Diego County
11:00-12:00	1.96	3.34	3.00	5.17	2.65	2.65	5.36
12:00-13:00	1.49	1.73	2.13	2.93	1.82	1.82	2.77
13-00-14:00	1.16	1.35	1.72	1.88	1.66	1.66	1.47
14:00-15:00	1.16	1.26	1.71	1.60	1.51	1.51	1.08
15:00-16:00	1.43	1.59	2.25	1.49	1.58	1.58	1.12
16:00-17:00	2.19	3.40	5.48	1.55	2.03	2.03	1.90

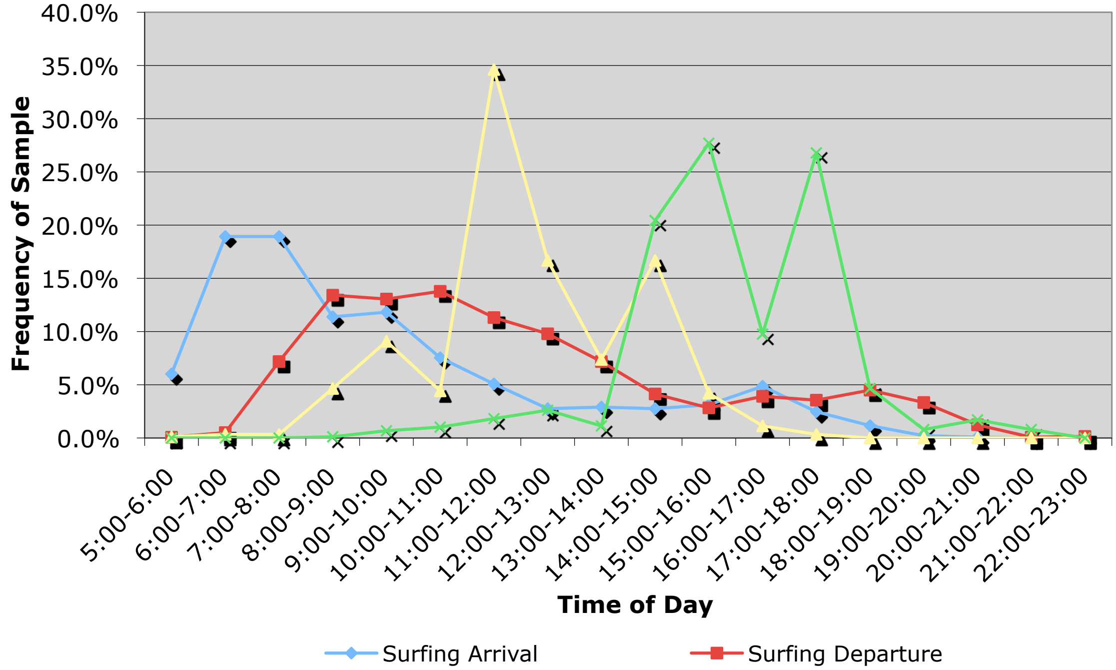

Figure 2: Arrival and departure frequency distribution for surfers and beach-goers

Table 4: Ratio of daily beach attendance: study estimates over official agency counts

Beach	Agecncy	Ratio
Gaviota	California State Parks	0.80
Refugio	California State Parks	1.36
El Capitan	California State Parks	0.90
Leadbetter	City of Santa Barbara	2.27
Carpinteria City	City of Carpinteria	1.51
Carpinteria State	California State Parks	0.32
Emma Wood	California State Parks	0.30
San Buenaventura	California State Parks	6.22
Mothers	Los Angeles County	0.68
Manhattan	Los Angeles County	0.64
Hermosa	Los Angeles County	0.60
Newport	City of Newport	0.35
CCSB	California State Parks	0.28
Doheney	California State Parks	0.19
Oceanside	City of Oceanside	0.19
Carlsbad	California State Parks	0.18
San Elijo	California State Parks	0.59
Cardiff	California State Parks	0.24
Del Mar	City of Del Mar	0.32
Torrey Pines	California State Parks	0.37
La Jolla Shores	City of San Diego	0.34
Pacific	City of San Diego	0.22
Mission	City of San Diego	0.55
Coronado	City of Coronado	0.38

Table 5: Results of econometric analysis

Number of Observations	F (8,677)	Probability > F	R-Squared	Root MSE
686	77.33	0.0000	0.4322	0.74097

logratio|	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
logbusyness	-0.617	0.033	-18.46	0.000***	-0.683	-0.552
logmeantemp	2.339	0.516	4.54	0.000***	1.327	3.351
logmeanwind	-0.146	0.069	-2.13	0.033*	-0.281	-0.012
lifeguardcount	0.478	0.211	2.26	0.024**	0.064	0.893
parkingcount	1.061	0.219	4.83	0.000***	0.630	1.492
day	0.290	0.062	4.66	0.000***	0.168	0.413
loglength	0.256	0.049	5.22	0.000***	0.160	0.353
cityagency	0.495	0.068	7.32	0.000***	0.362	0.627
_cons	-12.006	2.342	-5.13	0.000***	-16.604	-7.407

Table 6: Results of supplemental econometric analysis

Number of Observations	F (6,119)	Probability > F	R-Squared	Root MSE
126	149.08	0.0000	0.8484	0.3483

logratio|	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
logbusyness	-0.811	0.061	-13.31	0.000***	-0.932	-0.690
logbeachturnover	4.977	0.338	14.71	0.000***	4.307	5.647
loglotvehicle	2.087	0.194	10.75	0.000***	1.703	2.472
logstreetvehicle	1.178	0.145	8.11	0.000***	0.890	1.465
day	0.318	0.072	4.42	0.000***	0.175	0.460
season	0.199	0.063	3.16	0.002***	0.074	0.324
_cons	-7.108	0.652	-10.90	0.000***	-8.400	-5.816

EXHIBIT E

Valuing Beach Recreation Lost in Environmental Accidents

by

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February 5, 2000

Key words: Damages, valuation, natural resource damage assessment, recreation demand, beach recreation, travel cost, environmental economics, oil spill, benefits transfer

Abstract: This paper reviews methods that can be used to estimate the loss in use value associated with saltwater beach recreation in the case of an environmental accident, such as an oil spill. Particular attention is focused on methods for verifying beach attendance data and on transferring benefit estimates from other locales. The paper first reviews methods for estimating what reported attendance might have been had the accident not occurred. The next issue considered is how to verify reported attendance data and how to correct it when systematic inaccuracies are found. The paper then turns to the question of valuing a beach visit and reviews the relevant empirical literature.

I. INTRODUCTION

It is common that environmental accidents temporarily restrict ocean recreation opportunities. The *Amoco Cadiz* oil spill in 1978 damaged beaches in Brittany (Brown et al, 1983). The monetary value of lost beach recreation was part of the damages assessed against Amoco. In 1990, the *American Trader* oil tanker spilled oil just off Huntington Beach, immediately south of Los Angeles, closing some of the most visited beaches in the U.S. for a period of weeks or more.[1] Again, the value of lost beach recreation was a major factor in assessing damages against those responsible for the spill. In the late 1990s several beaches in Santa Barbara County, California were closed to swimming and other water contact sports for periods of several weeks. In this case the cause was bacterial contamination from storm runoff through creeks. In this case, estimating the value of value lost beach recreation would be an important step in formulating policy concerning the abatement of waterborne bacterial loads.

Although much has been done to improve methods for valuing recreation and other nonmarket environmental goods,[2] there is little published on the practical steps needed to generate an estimate of lost recreation value due to a closure. The purpose of this paper is to detail some of the issues that must be faced in generating damage estimates.

The typical situation in the case of an accident that affects beach use is that attendance drops, possibly to zero, during the affected period. After the beach reopens, the beach experience may be degraded for those who do attend. Furthermore, not all beach visits are the same. The second visit in a week for an individual is probably not worth as much as the first visit. Visits of different duration may be valued differently -- a two hour visit is not equivalent to two one hour visits. Conceptually, the correct way to view the value of lost beach visits is to first measure the surplus loss to an

individual and then aggregate over the population of individuals. This can be very difficult.

Practically speaking, the typical way of viewing damages is that all visits have the same value, and that total damage is the product of price (average value) and quantity (number of visits lost). The relevant academic literature has focused almost exclusively on the price component of this product, i.e., on valuation, and paid little attention to the quantity component. As shown shortly, however, estimating quantity also presents practical and conceptual challenges. One must attempt to estimate how many visits would have been made if the closure had not occurred. Inevitably, this requires the use of reported data on beach visitation for periods when the beach was open. As emphasized later, in cases where no admission fee or parking fee is charged and access is largely unrestricted, the task of measuring the number of visits is very difficult. In these situations the quality of reported visitation data is naturally open to question, and assessing the accuracy of visitation data becomes an important part of the analysis.

II. BEACH ATTENDANCE

The first question to ask is how much would the beach in question have been used but for the accident? This is not an easy question to answer quantitatively. There are three time periods to be concerned about: the period when the beach is officially closed, for clean-up purposes or for public health reasons (closure period), the period when the beach is open but the experience is degraded because there is still evidence of pollution (physically degraded period), and the period when the beach is physically clean yet the

memory of the accident is fresh enough that the quality of the experience may be somewhat degraded (perceptually degraded period).

Normally, researchers can only deal with lost attendance during beach closure or possibly in the period immediately following beach closure. Because daily beach attendance fluctuates dramatically and for a large variety of reasons -- an interesting sports broadcast on local TV can dramatically reduce attendance -- it is hard enough to estimate what the attendance might have been if the beach were not closed. Although it is desirable to estimate lost attendance during the physically and perceptually degraded periods, that is often not possible.

To estimate beach attendance but for the accident, one must answer two basic questions: what would reported attendance have been but for the accident, and does actual attendance differ systematically from reported attendance? As will be discussed later, these are two very different questions, and the second question regarding data accuracy can be very important. For beaches with controlled access, such as through parking lots and entrance booths, estimating actual attendance on any given day is straightforward and generally accurate. However, many beaches do not have limited access points but are bounded by a boardwalk or path adjacent to shops and other urban amenities. Measuring the number of beach visits at such beaches is difficult and is subject to more error.

Most well attended beaches maintain attendance records, often daily. In California, this applies to beaches at State Parks as well as many municipal beaches. To estimate the damage from an accident, one must estimate (1) what reported attendance would have been had the accident not occurred and (2) how much reported attendance estimates differ from actual attendance. We consider these two issues below.

A. "But For" Reported Attendance

The first question, "What would reported beach attendance have been but for the accident?" is best viewed as an econometric question. Given daily, or perhaps weekly or monthly, data on attendance covering a substantial historic period, a model of beach attendance can be estimated. This model can then be used to simulate the counterfactual of the affected beach being open.

Conceptually, beach attendance is complex. Whether someone goes to the beach depends on what other recreation opportunities are available, including sports events on and off television, weather, at the beach and elsewhere, the opportunity cost of the visit, and other factors including how many recent opportunities there have been to attend the beach. Although it is possible that a structural model of beach attendance could be constructed, it is not easy to represent the beach choice problem, particularly when there are a number of close substitutes. A reduced-form time-series approach is easiest to implement and probably most practical.

In constructing a model of beach attendance at southern Los Angeles area beaches in the context of the *American Trader* oil spill, Paul Ruud estimated a vector autoregressive (VAR) model of attendance: attendance is affected by contemporaneous variables, such as weather, day of the week, and season, but also lagged attendance at the beach and at other beaches. VAR models are commonly used in macroeconomic forecasting. Including lagged attendance reflects the fact that errors from examining only contemporaneous variables will tend to be temporally autocorrelated (Ruud, 1994; Dunford, 1999). All other things being equal, if yesterday was a day that attracted a large number of beach visitors, then it is likely that today will also attract many beach visitors.

One problem with using a VAR model to simulate the counterfactual is that observations on lagged beach visits, absent the accident, are unavailable. Thus it is important to try (a) to include as many appropriate contemporaneous variables as possible; and (b) to use lagged attendance at beaches outside of the accident area rather than within the accident area.[3] This may not always be feasible however. The less desirable alternative, of using forecast attendance at the study site and lagging it for subsequent forecasting, can cause errors to be compounded.[4]

As was mentioned earlier, another issue concerns the duration of the damage period. This is not much of an issue when the beach is completely closed. But in other cases the beach may be closed only to some activities; e.g., swimming and surfing. Also, after the beach opens the quality of a visit may be degraded, or people may not be immediately aware that it has reopened. Clearly, there is some period of time immediately following actual closure where one can expect attendance to be reduced.

B. Correcting Reported Attendance

Reported beach attendance may not correspond to actual beach attendance, and actual beach attendance clearly is what is needed to estimate damages. Thus the second step, and the one considered in this section, is to identify and correct for any systematic discrepancy between reported and actual beach visitation.

In this regard, we can separate beaches into two types: those with limited access and those without limited access. Limited access beaches have restricted entry points where one can observe entry and exit. Open access beaches on the other hand are freely accessible, so observing entry and exit is

difficult at best. Each type of beach requires a different approach for verifying and, if necessary, correcting reported attendance.

1. Limited Access Beaches. For limited access beaches, parking is often monitored to generate attendance estimates. For State Beaches in the Los Angeles area, authorities generally charge for parking and thus have fairly accurate counts of the number of cars "using" a particular beach. Authorities make assumptions regarding the average number of occupants per vehicle as well as the average ratio of "walk-ins" to vehicles. To the extent that assumptions about these ratios and averages are based on observation, this is a reasonably accurate and cost-effective way to estimate attendance. Problems arise when walk-ins and automobiles are not highly correlated. Further problems arise from people who walk along a beach, since it is difficult to exclude entry near the shoreline. In assessing the accuracy of reported attendance at limited access beaches, it is important to verify that the car counts are accurate, that the assumed occupancy rate is accurate and that the ratio of "walk-ins" to automobiles is accurate. Accuracy can be judged by random sampling of individuals on the beach or of individuals arriving at the beach.[5] If the underlying assumptions are not accurate, the analyst can correct reported attendance figures appropriately.

2. Open Access Beaches. Attendance at open access beaches is more difficult for authorities to measure and more difficult for the analyst to verify. This was illustrated in the controversy over the National Park Service's estimate of participation in the "Million Man March" on the Mall in Washington on October 16, 1995. The Park Service estimated attendance at 400,000, whereas the organizers estimated attendance at 2 million. Subsequent analysis of aerial photos by Boston University placed the figure between 700,000 and one million (Daly and Harris, 1995). It is not easy to estimate the size of crowds.

This suggests that aerial photos are one reliable way to estimate the number of people over a large area.[6] However, aerial photos are prohibitively expensive as a way to generate regular estimates of attendance. Newport Beach, California asks lifeguards to estimate attendance at different points in time during a day and from these estimates, beach attendance is computed. Huntington City Beach, California, another open access beach, also uses lifeguards to estimate attendance, though relying more heavily on car counts in parking lots (Chapman et al, 1998).

One could take aerial photos of the beach at different points in time during a day and count the number of people in the photos. A problem, however, is that aerial photos only give the stock of people at a point in time, not the number of visits. One can, however, estimate the number of distinct visits by combining information on the stock of visitors at various points in time, e.g., from aerial photo counts, with information on the duration of visits. The basic idea is simple. If one knows the stock of people on the beach as a function of time throughout the day, the total number of “person hours” at the beach can be computed by integrating this function over the day. Dividing person hours by the average duration of a visit then gives the number of separate visits.

To illustrate the procedure, we discuss below our estimates of beach visitation at Newport Beach and Huntington City Beach over several days in the Spring of 1995. Because aerial photographs are expensive, we carried out the analysis for only five days, three weekend days and two weekdays, and present results from two days in what follows. The procedure is divided into two parts: establishing the number of people on the beach at each time during a day, and converting the estimated time profile of this stock of visitors to an estimate of visits. The first task is accomplished with aerial photographs. The second is accomplished by estimating average visit duration with data from a survey of arrival and departure times.

a. Stock of People on the Beach. A major component of computing the actual attendance is an estimate of the number of people physically on the beach, bikepath, pier, parking area, water and playgrounds at any point in time during a day: B(t).[7] Our approach was to take aerial photos at three times during the day, 11 a.m., 1:30 p.m. and 4 p.m. for the entire beach in question. We assumed zero attendance at 6 a.m. (before sunrise) and did visual counts of attendance at several other points in the early morning. Manual night counts of attendance were also conducted for times after 6:00 p.m.

We were unsure exactly when the peak beach attendance occurred during the day. The counts from the 1:30 p.m. photos were higher than the 11 a.m. or 4 p.m. photos, suggesting the peak occurred close to 1:30 p.m. We assumed that B(t) was constant at the 1:30 value between 12:30 and 2:30 p.m. Linear interpolation was used for other times during the day to produce an estimate of B(t) for all t between 6 a.m. and 6 p.m. The last aerial photos were taken at approximately 4 p.m. The night counts allowed us to estimate beach attendance at 6pm.

b. Duration of Beach Visits. Having established the time profile of the stock of visitors, we need an estimate of the duration of beach visits in order to compute the number of visits. To compute duration, it is necessary to survey visitors. For instance, surveyors can randomly intercept individuals on the beach, ask their arrival time, expected departure time, and expectations about temporarily leaving the beach during their visit. From this, it is straightforward to compute the duration of their beach visit. However, the goal is to estimate the average visit duration over the population of beach visitors and this sampling procedure tends to over-sample visitors who make longer visits. For any sampling rate, a visitor who stays at the beach all day is far more likely to be surveyed than someone who is only there 20 minutes.

Both types of visits count equally as "visits" for the purpose of estimating lost recreation value.[8]

To correct for over-sampling of long duration trips, each observation in the sample must be weighted by the probability of being sampled.[9] For the i^{th} member of the sample, let a_i denote the arrival time, x_i the gross duration of the visit (including time spent away from the beach), and r_i the time spent away from the beach in restaurants and shops. The net duration of i's visit, m_i, is simply $x_i - r_i$. Further, let S(t) be the sampling rate (people per hour) at time t and recall that B(t) is the number of people on the beach at time t. Define the sampling proportion as the ratio of these two, s(t)=S(t)/B(t), the fraction of people on the beach sampled per hour at time t.

Given that a respondent is on the beach, the probability, $?_i$, that visitor i will be sampled is proportional to the fraction of beach visitors are sampled during the i's visit:

$$?_i \propto ?_{a_i}^{a_i+x_i} s(t)\ dt \equiv \delta_i \qquad (1)$$

Eqn. 1 is simple to interpret.[10] Suppose an individual is at the beach for four hours and suppose also that the sampling rate is constant at 1% per hour over that period, which would be true if the number of people on the beach is constant and the number of people sampled per hour is constant. If we continually sample 1% of the people on the beach every hour, then the integral in Eqn. (1) is simply the duration of the visit times the sampling rate. In this case (constant sampling rate) the probability that i is sampled is proportional to the duration of i's visit.[11]

This is a problem in sampling theory, where the sample is not random. The goal is to determine the mean duration of the entire population of beach visits. Let f(x) be the unknown population density of visit durations (x) and g(x) the known sampling distribution. We seek to estimate the mean visit duration based on the population density, which we denote by . Utilizing the fact that sampling is proportional to visit duration and the number of visitors on the beach, as discussed in the context of Eqn. (1), this implies (Cox, 1968) that

$$g(x) \qquad = \qquad [\delta(x)/\Delta]f(x) \qquad\qquad (2)$$

where Δ is a constant of proportionality that makes g integrate to one and $\delta(x)$ is the weight associated with a visit of duration x, developed for the discrete case in eqn. (1). Thus 1/ is equal to the expectation of 1/ (x) with respect to the sampling distribution, g. Rearranging Eqn. (2), multiplying both sides by x and integrating, we obtain

$$_g[x \quad / \quad (x)] \qquad = \qquad E_f[x] \qquad\qquad (3)$$

where E_g and E_f are expectations with respect to the distributions g and f, respectively. Unbiased estimates of and , ^ and ^, can be obtained from a sample of size N:

$$1/^{\wedge} \qquad = \qquad (1/N)\Sigma_i(1/\delta_i). \qquad\qquad (4)$$

$$^{\wedge} \qquad = \qquad (1/N)\Sigma_i(^{\wedge}/\delta_i)m_i. \qquad\qquad (5)$$

To implement this procedure we calculated the sampling rate on an hourly basis for each beach. For example, for Newport Beach during the period 10 a.m.-

-11 a.m., we divided the number of surveys executed during that hour by the average number of people on the beach during the hour. This sampling rate was considered to be constant over the hour when calculating δ in Eqn. 1 for surveys completed during that hour. The average durations of visits at the beaches surveyed are reported in Table 1.

c. Estimating Visitation. Given an estimate of the average duration of a beach visit (m), and the time profile of the stock of people on the beach at any given time during the day, it is straightforward to compute the number of distinct beach-visits. The integral under B(t) from 6 a.m. to 6 p.m. gives the number of person-hours spent on the beach during the day. The estimated number of daytime beach visits is simply

$$V_D = \Omega_D/m \qquad (6)$$

This is, of course, only an estimate of day visits. To be complete, one should spot check night attendance.

Table 1 shows the results of this calculation for Newport Beach and Huntington City Beach, two beaches south of Los Angeles, for two days in 1995. Table 1 also shows attendance figures reported by the government agencies that operate those beaches, using the lifeguard count methods described earlier. Evidently, the lifeguard counts significantly overstate actual attendance. On the busiest day at Newport Beach, reported visitation exceeds the estimate based on aerial photos by a factor of almost five.[12]

III VALUATION METHODS

There are two general approaches to monetizing the value of lost beach visits. One is to use what has become known as benefits transfer. This

involves surveying the literature on empirical analyses of the value of similar goods. Based on this literature, an inference is drawn about the value of a lost recreation day at the beach being considered.

The second approach is to conduct a valuation study at the beach subject to closure. This can be expensive but has the obvious advantage of applying directly to the beach of interest. There are two basic empirical methods for valuing beach recreation, contingent valuation and travel cost.[13] Contingent valuation involves surveying beach visitors. These surveys include questions such as "If, in order to maintain beach quality, it became necessary to institute a fee of $9 per day to visit this beach, would you continue to visit?" By comparing responses to such questions with characteristics of the respondent and varying the reservation fee proposed, estimates of willingness to pay for a beach visit can be deduced, at least in principal.

A second empirical approach to valuing beach recreation involves determining how travel costs affect beach visits This is a widely used method, dating back to the 1940s. If one can observe the cost an individual bears when making a beach visit, one may infer that the visit must have been worth at least as much as the cost. Thus, travel cost plays the role of a price, and demand may be estimated. While the basic premise is valid, the travel cost method is not without problems. At least three issues arise in implementing the travel cost method for determining the value of lost beach recreation. One concerns the sampling frame. Should visitors to the beach be sampled, the common approach, or should the population of possible visitors be sampled, a much more costly but less problematic approach (see Hausman et al, 1995). Second, how should one deal with the value of travel time? Certainly it is related to an individual's wage, but does it equal the wage?[14] What about children and the unemployed? A third issue concerns the treatment of visit. Considering visit duration explicitly is important because visits of different

length probably are not are equally valuable, and those travelling a long distance to the beach are likely to stay longer,

These problems are particularly thorny in the case of multi-day and multi-purpose trips, where it becomes difficult to associate specific components of travel cost to specific recreation activities. For instance, if someone travels from the U.S. to Barcelona for three weeks, visiting beaches, museums and enjoying Spanish food, art and culture, it may be difficult to measure the value of a beach day in Barcelona based on total travel expenditures. The travel cost method is better suited to single purpose trips of short duration.

An important issue in any recreation valuation study is the treatment of substitutes. If a perfect substitute beach exists, then the damage from being excluded from the closed beach cannot exceed the travel cost to the substitute. Even if the alternative beach is not a perfect substitute, it can still limit surplus loss from the closed beach. However, estimating demand for several sites that are imperfect substitutes is difficult.

A further complication is temporal substitution.[15] Temporary closure may cause a beach visit to be deferred by several weeks, but not lost permanently. It is unlikely that deferred visits and permanently lost visits are equally costly. Put differently, valuation studies usually consider only the permanent addition or permanent subtraction of beach recreation opportunities. An accident causes temporary loss of recreation opportunities, however, and consumers may respond by substituting across time, postponing visits until the beach reopens. To what extent do consumers substitute across time? If the delayed beach visit is a perfect substitute, then there is no loss from the temporary closure. It is likely that visits at different points in time are

only imperfect substitutes, however, which brings us back to the difficult estimation issues associated with spatial substitution.

An additional concern is the loss associated with degraded beach visits. If the quality of a beach visit can be quantified, e.g., if pollution levels are observed, then it may be possible to estimate the surplus loss from a degraded visit. Such quality-considerations have been introduced in some studies, as noted shortly, but not in the context of environmental accidents. [16]

A. Summary of Other Studies.

An inexpensive approach to estimating the value of a lost beach visit is to transfer an estimate of the value of a lost visit prepared for another context to the beach of interest. Basically, one surveys the literature on beach recreation and generates a best estimate of the value of a visit at the beach in question. To assist in using benefits transfer, we provide a review of benefits estimates for saltwater beach recreation. [17]

A word of caution is in order in conducting benefits transfer. One must be aware of the nature of the good being valued. With a beach visit, is this a summer visit, a winter visit, a day trip or a multi-day trip? Is the visit primarily to use the beach or to use the water? Should the analysis include boaters, surfers, whale watchers? Clearly, these questions must be addressed when transferring benefit estimates from elsewhere.

There appear to be thirteen relevant studies of the value of saltwater beach recreation. All use either the contingent valuation (CV) or travel cost approach. A number of other studies of water recreation or the value of water quality improvements at recreation areas were also identified. However, they are less useful for determining the value of a lost saltwater beach recreation day for residents.[18]

Table 2 summarizes the values estimated for a beach day visit in the studies examined. The table shows the values taken directly from the studies (column 2) and values inflated to common (1990) dollars using the consumer price index. When reviewing the Table, keep in mind that each of these studies was done in a different context so they may not be directly comparable.

The majority of these studies used the CV method. Although quality is always an issue in economic analysis, this is particularly important with CV studies, because the nature of the survey instrument can significantly shape the results obtained. To provide guidance as to the validity of the CV method and to outline proper protocols to use in CV studies, the U.S. National Oceanic and Atmospheric Administration (NOAA) convened a "blue-ribbon" panel of experts to conduct an independent review of these issues (the "NOAA Panel"). The panel, convened in 1993, concluded that CV can provide useful information, but surveys should be constructed with considerable care.[19] These findings were subsequently embodied in NOAA regulations on the conduct on Natural Resource Damage Assessments.[20] The guidelines are detailed, and include such general recommendations as using referenda rather than open-ended questions, using personal rather than mail surveys and carefully pretesting the survey instrument. Most of the CV studies reviewed here predate these guidelines. The state-of-the-art of CV has evolved considerably over the last two decades.

In order to shed light on the context in which these studies were conducted, as well as the strengths and weaknesses of the methods used, we now review some of these studies below.

B. Details of Selected Studies

1. Bell and Leeworthy. In 1986, Frederick W. Bell and Vernon R. Leeworthy published a study on the value of Florida beaches . The authors were interested

in the value of a day visit to the beach and the direct and indirect economic effects from beach use for both the resident population and tourists from out-of-state.

The data for their study came from a statewide survey conducted in March, 1984 concerning beach use in the state during the previous twelve months. Information was obtained on the number of times the respondent had visited the beach, aggregate expenditures involved in visiting beaches, as well as characteristics of the individual -- information necessary for travel cost analysis and contingent valuation.

The travel cost method for valuing recreation resources is well known and widely used. However, Bell and Leeworthy did not examine travel costs, but rather focus on total direct expenditures associated with recreating. To draw the distinction, they included expenditures on meals and lodging, expenditures that may in fact be part of the recreation experience rather than the cost of making a trip. They also excluded the value of time associated with traveling to the recreation site. Another difficulty with their approach is that the visitation rates and beach expenditures used in estimation are not modeled in a way that takes specific attributes of the beach visited into account

To obtain a CV estimate of the value of a beach visit, the authors asked the following question:

> Because of beach erosion and other beach related problems, suppose it became necessary for beach users to agree to buy an annual pass which allows you to visit all public beaches in Florida. The money collected would pay for preservation of the beach. What is the maximum you would be willing to pay for the annual beach pass, in addition to any current beach fees?

This yields a CV estimate of the value of a lost beach day. The authors, apparently concerned that responses to this CV question were low, adopted a multiplicative adjustment factor of 3.003 drawn from a study of goose hunting permits done by Bishop and Heberlein (1979). This adjustment factor was intended to adjust for a supposed downward bias in responses to willingness-to-pay questions relative to what would be expected in an actual market. While there is a good deal of evidence in the literature that willingness-to-pay is less than willingness-to-accept compensation, there is no consensus on the appropriate adjustment. In fact, the difference is large in some studies and small or negligible in others.[21]

2. McConnell (Rhode Island) In 1974, Kenneth E. McConnell surveyed visitors at Rhode Island beaches in order to measure willingness-to-pay for beach visits and the effect of crowding.[22] A series of questions was posed to the beach- goer involving a hypothetical price and whether he or she "would come to the particular beach on the particular day for that price?" with the suggested price sequentially incremented by $0.50. Thus a series of yes/no responses is collected, resulting in a CV estimate of maximum willingness-to-pay. Other information was collected in the surveys, including family income and the number of visits per season. Hourly temperature and daily attendance at the beach were also recorded.

McConnell regressed these individual willingness to pay responses against family income, congestion at the beach, temperature at the beach, and per season visits of the individual, obtaining the following equation:

$$\ln w = -4.7 + \underset{(1.0)}{0.00001}\, y - \underset{(2.5)}{0.0025}\, q + \underset{(2.5)}{0.076}\, t - \underset{(9.3)}{0.058}\, x \qquad (7)$$

where t-statistics are in parentheses and w is per-capita surplus or willingness to pay ($/person), y is family income ($/year), q is congestion (attendance/acre), t is temperature (^{o}F), and x is visits of the ith individual to the beach.[23] Note that while the coefficient on income is not significant, the coefficients of the other variables are significant at conventional levels. The R^2 for the estimated equation is 0.29.

While McConnell does not report enough information to calculate the mean value of a beach-day, one can obtain estimates from what is reported. Since congestion is an externality, he first computes the socially optimal level of congestion (q) and finds it to be 400 per acre. For a fixed acreage of beach, lower congestion provides higher utility to fewer people; higher congestion provides lower utility but to more people. Median family income in Rhode Island in 1974 was approximately $13,725. The mean value of x is not known, but it is evident that increases in x reduce the willingness-to-pay. The mean value of q is similarly unknown but increases in q reduce willingness-to-pay. There are two obvious assumptions regarding congestion: one is that it is optimal (at 400); another is that it is zero, yielding the highest willingness-to-pay in Eqn. (7). For instance, assuming congestion is optimal, Eqn (7) can be used to calculate the value of a beach-day as a function of temperature for an individual belonging to a family with median income. Carrying out this calculation yields the figures in Table 2. Willingness-to-pay would be higher for zero congestion. The fact that we do not know the level of congestion (q) suggests that these figures are subject to considerable uncertainty.

3. Binkley and Hanemann In 1978 Clark Binkley and Michael Hanemann published an analysis of the value of beach recreation and water quality improvements for beaches in the Boston area.[24] This is among the more carefully designed and executed studies of beach recreation available. The authors collected data on

beach recreators in the Boston area by administering approximately 500 in-person interviews in December, 1974. The survey instrument included a large variety of questions on beach use. The authors were interested in estimating a model of site demand that explicitly considered choice among alternative beaches. Thus they asked questions of the following nature (the questions are paraphrased):

1. How many times during the past summer did anyone in your household visit specific beaches in the Boston area?

2. How long did it take for you to get to each beach and how much did it cost for you to travel there and back?

3. Why do you visit __(site name)__ most often?

4. If this site became much more polluted, what would your response be?

5. How much would the cost of this site have to be raised before you would start visiting your second most favorite site more? (WTP1)

6. Suppose your favorite beach were to become very polluted. This could be avoided if sufficient funds were collected. How much would you pay to prevent this deterioration in water quality? (WTP2)

7. Suppose with appropriate funds, the water quality of your favorite site could be dramatically improved. What is the most you would be willing to pay for this? (WTP3).

Although the authors collected travel cost information, including time, they did not calculate travel cost or carry out a travel cost analysis of the value of a beach-day.

An interesting feature of this study is its emphasis on substitute sites. The authors asked a series of questions with the obvious intent of learning why one site is chosen over another. For instance, question 3 seeks to determine why the respondent chose the most commonly visited beach. The most frequent response to this question is proximity (47.5% of respondents). The second most frequently cited reason (12.3% of responses) is that the respondent's friends go there. A lack of crowding was the most important factor for only 3.6% of respondents. The importance of proximity suggests that the effort involved in traveling is a major determinant in deciding which beach to visit. Furthermore, in response to question 4 above, 56.9% of the respondents said they would switch to another site should their favorite site become very polluted. This suggests the important role of other beaches as substitutes when one's preferred site becomes unavailable or unattractive.

In what was basically a CV study, the authors used several different questions to elicit willingness-to-pay. They first asked the willingness-to-pay to move to the respondent’s second favorite site (WTP1). This should provide an estimate of the incremental value of the favorite beach. The authors also asked two other questions related to water pollution: how much the respondent would be willing to pay to avoid increased pollution (WTP2), or to improve water quality from the current state (WTP3).

Binkley and Hanemann report mean and median responses to all three of these willingness-to-pay questions. Interestingly, mean responses to the three willingness to pay questions are in a very narrow range ($1.98-$2.08). Median responses are lower but fairly similar ($1.08-$1.24). The authors also attempted, unsuccessfully, to estimate an ambitious multiple site demand model, taking into account characteristics of multiple sites.

4. Moncur One of the few true travel cost analyses of beach recreation was done by James Moncur (1975) for beaches on Oahu, Hawaii. He focused on recreation on the island by local residents. According to him, all residents were within 40 miles of all of the beaches.

His approach was to conduct a mail survey (in 1972) of a sample of the Oahu population. Although his sample size was large (several thousand), his response rate was modest (31%). Using ZIP code to identify each respondent's location he calculated the travel distance and travel cost to each beach for each respondent. Unfortunately, he does not provide much information on exactly how travel costs were computed.

Moncur estimated a model that specified the per person visitation rate as a function of the travel cost to each of eleven beach areas. He then calculated a population demand function for each beach and measured the surplus associated with each beach, holding the price of other beaches constant. Moncur was then able to calculate the surplus per person-beach-day for nine of the beaches examined. Those figures are on the order of $1 per beach day (1972 dollars) and are given in Table II. Significantly, this is one of the few studies that looked at the cost of visiting substitute beaches when calculating the value of a specific beach.

5. NOAA Public Area Recreation Visitors Survey (PARVS) Since 1987, the National Oceanic and Atmospheric Administration (NOAA) has been conducting surveys of coastal recreation sites in the U.S. According to Leeworthy, Schruefer and Wiley (1991), over 15,000 interviews have been conducted at various recreation sites. These surveys involved intercepting visitors at particular beaches, administering a questionnaire in-person and giving the respondents a written survey to complete later and mail back. Data collected

include responses to CV questions on the value of beach recreation and information that would permit an analysis of travel expenditures.

The CV portion of the survey included the following question:

> Suppose the agency that manages this site started charging a daily admission fee of [random number] dollars per person. The money from the admission fee will be used to maintain the site in its present condition, but there would be no improvements. Would you continue to use this site?[25]

Responses indicate that the median value visitors assign to using these beaches is typically under $6. Similar values were reported for approximately two dozen other beaches around the country. With the exception of one beach in Oregon, for which the median value of a beach day was $13, all beaches generated median values less than $7 per day.

Leeworthy and Wiley also used the NOAA surveys to relate the number of trips to a particular beach to a variety of factors, including travel cost.[26] The beaches considered are three Southern California beaches, one New Jersey beach and two Florida beaches. These analyses suffer from several shortcomings, however.

One flaw is evident in the treatment of travel cost, which is set at $0.13 per mile traveled, for all visitors. The authors effectively aggregated together trips of very different types. A three week trip to Florida from England was treated as the same commodity as an afternoon's excursion to a Florida beach by a local resident. Furthermore, and perhaps more important, the trips per year variable, which is used as a regressor, will likely be biased upwards due to the nature of the question pertaining to visitation rates. Respondents who have traveled a long distance to the beach, e.g., from England

to Florida, may only make one trip every several years, or even one in a lifetime. Failing to recognize this introduces an important source of error into the data used for estimation.[27]

It should also be pointed out that the NOAA analyses cannot be used to determine the value of a specific beach because costs of using substitute sites are not included in the estimating equations. To see the importance of this, consider the estimated demand function for beach visits at Clearwater Beach in Florida. This equation indicates that if an admission price of $400 per person were imposed there, with no fees at other beaches, people would continue to visit, though cutting back to a mean rate of one visit per year from a mean of 6.8. This is simply implausible. Rational consumers would find substitute sites for beach recreation under these circumstances.

The NOAA data sets represent a large, potentially useful set of data for future empirical work on the value of recreation. To date, however, the analysis carried out with these data has suffered from important shortcomings.

6. Bockstael, McConnell and Strand Nancy Bockstael, Kenneth McConnell and Ivar Strand undertook a major analysis of the benefits of water quality improvements in the Chesapeake Bay (Bockstael et al, 1988). Although the authors examined a variety of types of recreation, of interest to us is their analysis of beach use on the Maryland western shore of the Bay.

Research Triangle Institute, working with the authors, surveyed a large number of visitors to twelve beaches during the summer of 1984. They then undertook two travel cost analyses of beach use. The authors used two models to estimate beach demand: a varying parameters model and a discrete choice nested multinomial logit model. As the authors state, neither was perfect for the application. The varying parameters model assumed each visitor used each

of the twelve beaches during the season. The discrete choice model has a number of well-known problems, including the difficulty in representing demand for multiple trips to the same site.

For the varying parameters approach, the authors specified a model in which the number of trips to a specific beach for a specific household depends on a) out-of-pocket travel expenses (mileage and admission fees), b) trip time, c) trip expenses and time for a single substitute beach, and d) ownership of a boat, RV or pool. Thus, the authors explicitly take into account substitute recreation opportunities. It appears that the specification used yields estimates of a household demand function rather than a single user's demand.

The demand function the authors specified is linear, and consumer's surplus per trip can be calculated for the mean number of trips from the results they report.[28] Performing this calculation yields a household consumer surplus of $4.70 to $38.50 (1984 dollars) for the six beaches with significant own price coefficients. The authors do not report average household size. Assuming an average household size of 3.78,[29] the per person value of a beach visit ranges from $1.24 to $10.19, and values for five of the six beaches are between $1.24 and $3.04. The average value over the six beaches is $3.23. Note that results for one beach are much higher than for the other five. This beach also had the highest cost of substituting to another beach, with travel time of over one hour. This isolation, i.e., lack of cheap substitutes, could explain the high estimated value.

7. McConnell (New Bedford) Kenneth E. McConnell participated in a telephone survey of beach use in New Bedford, Massachusetts (McConnell, 1992). The issue of interest was damages from PCB contamination of the area's beaches, so the sites studied may be less desirable than a typical beach. The survey was conducted in March 1986 of 545 New Bedford area households. Respondents were

asked about their residence location and the annual number of visits they take to each of two beaches in the area. They were also asked how frequently they would visit if the PCBs were cleaned up. Thus, the contingent valuation question pertains to how many visits they would make if the pollution were eliminated. The author estimated a travel cost model for each beach, and included the travel cost to substitute beaches as a factor affecting use. From this, consumer surplus per beach visit per person can be calculated, both with PCBs and without. The resulting values for a beach day are very low; using the median number of visits (instead of the mean), yields values per beach day without PCBs of $0.58 to $0.94 (1986 dollars).

C. Summary of Studies

What can be learned from this review? Our first conclusion is that none of the studies is perfect. Most of the CV studies were relatively primitive by today's standards; few reflect the recommendations of the NOAA panel. The CV questions were often open-ended and were rarely posed as realistic decisions trading off some expenditure with the provision of a good. Of the CV studies, three seemed to be the best, though not without problems: Binkley and Hanemann, McConnell (Rhode Island), and the NOAA studies.

The travel cost studies also vary in quality. Typically, travel costs are imprecisely or incorrectly computed, demand equations are improperly specified or substitutes are omitted. The NOAA travel cost studies had so many problems that we excluded them from our tabulation of beach value estimates. The Bell and Leeworthy study also had sufficiently serious flaws that we would advise excluding their results from the set of defensible values of a beach day. Of the travel cost studies, two appeared to be the best, though again not without problems: Moncur and Bockstael et al.

Turning to Table 2, the CV studies are remarkably consistent in the values they report for a beach day. Despite variability in the type of CV question posed, all studies yield values of a beach-day from under a dollar to almost six dollars, with the preponderance of values between one and four dollars per day. The two studies that provide for seasonal or temperature variation indicate that values do vary substantially by season.

The travel cost/travel expenditure studies have a wider range of values than the CV studies, in part because of the range of choice researchers have in analyzing the data, e.g., in functional form for demand and in computing travel cost. Of the two travel cost studies that seemed most carefully done, one (Moncur) generates values consistent with the CV studies, $1-$4 per day. The other (Bockstael et al) finds that values for five of the six beaches considered have values of $1-$4 per day as well, consistent with the CV numbers. One of their beaches yielded a value of $12.47, but this probably results from its isolation and lack of inexpensive substitutes. All of the other travel cost studies, excluding the problematic ones mentioned above, obtained values of $1-$3 per day.

Overall, the bulk of the existing literature places the value of a saltwater beach day, independent of season, in the range of $1-$4. Some studies place the value as high as $12, but these appear to suffer from significant flaws. Also, these values apply to day-use, not overnight tourist use.

V CONCLUSIONS

This paper reviewed some of the problems and methods associated with estimating the damage from lost beach recreation due to an environmental accident. We focused on estimating lost attendance and on transferring the

value of a lost beach day from other studies. Clearly, the option of conducting one's own study of the value of beach recreation for the beach affected by the environmental accident should also be considered.

One of the more important conclusions reached is that lifeguard counts of beach visits may well be inaccurate, with over-reporting by as much as a factor of almost five on a busy day. Aerial photos, combined with on the ground surveys of trip duration, can be used to provide defensible estimates of visitation.

The literature on valuing saltwater beach recreation places the value of a beach day in the $1-$4 range (1990 dollars). There is considerable room for improvement in our understanding of these values, however. Most of the CV studies of beach recreation are now fairly old, and generally did not use methods that are up to the present state-of-the-art. Some of the travel cost studies have shown the importance of including visit-specific or site-specific attributes, such as crowding, temperature, and season. Most travel cost and CV studies have ignored such considerations, however, in their design. The travel cost literature on beach recreation is often very casual about how travel cost is actually computed, sometimes to the point of ignoring time costs. Both travel cost and CV studies often fail to incorporate opportunities to visit substitute sites in the study design.

Finally, none of the studies completed to date sheds light on the potential for substituting visits over time; i.e., on the loss the recreationist experiences when a trip is delayed, but not eliminated entirely. This is, arguably, a very important gap in our knowledge with regard to assessing the damages from temporary beach closures.

VI REFERENCES

Bell, Frederick W. and Vernon R. Leeworthy (Feb. 1986). "An Economic Analysis of the Importance of Saltwater Beaches in Florida," Florida State Sea Grant College Report SGR-82, Florida State University.

Binkley, Clark S. and W. Michael Hanemann (June 1978). "The Recreation Benefits of Water Quality Improvement: Analysis of Day Trips in an Urban Setting," US Environmental Protection Agency Report EPA-600/5-78-010, Washington, DC.

Bishop, Richard C and Thomas A. Heberlein (1979). "Measuring Values Of Extra-Market Goods: Are Indirect Measures Biased?," *Am J Agr Econ*, **61**:926-930.

Bockstael, Nancy E., Kenneth E. McConnell and Ivar E. Strand (April 1988). "Benefits from Improvements in Chesapeake Bay Water Quality," EPA Report, final draft.

Braden, John B and Charles D Kolstad (1991). *Measuring the Demand for Environmental Quality*, North-Holland, Amsterdam.

Brown, Gardner M., Jr., Richard Congar, and Elizabeth A. Wilman (1983). "Recreation: Tourists and Residents," Chapter 4 in U.S. National Ocean Service, *Assessing the Social Costs of Oil Spills: The Amoco Cadiz Case Stud* y, National Oceanic and Atmospheric Administration Report NTIS PB84-100536, Washington, DC.

Chapman, David J., W. Michael Hanemann, and Paul Ruud (Nov. 1998). "The American Trade Oil Spill: A View from the Beaches," *AERE Newsletter*, **18**(2):12-25.

Cox, D.R. (1968). "Some Sampling Problems in Technology," in N.L. Johnson and H. Smith (Eds), *New Developments in Survey Sampling*, Wiley, New York.

Curtis, T.D. and E. W. Shows (Sept. 1982). "Economic and Social Benefits of Artificial Beach Nourishment Civil Works at Delray Beach," Department of Economics, University of South Florida.

Daly, Christopher B and Hamil R. Harris (October 28, 1995). "Boston U. Sets March At 837,000; Estimates Hinge On Crowd Density," Washington *Post*, p C3.

Dornbusch (David M.) and Co., Inc. (April 1987). "Impacts of Outer Continental Shelf (OCS) Development on Recreation and Tourism," Minerals Management Service Report MMS 87-0066, San Francisco, CA.

Dunford, Richard W. (May 1999). "The *American Trader* Oil Spill: An Alternative View of Recreation Use Damages," *AERE Newsletter*, **19**(1):12-20.

Freeman, A. Myrick III (1993). *The Measurement of Environmental and Resource Values: Theory and Methods,* Resources for the Future, Washington, DC.

Hausman, Jerry A., Gregory K. Leonard, and Daniel McFadden (1995). "A Utility-Consistent, Combined Discrete Choice and Count Data Model Assessing Recreational Use Loses Due to Natural Resource Damage," *J. Public Econ.*, **56**:1-30.

Heilbrun, James (1993). *Urban Economics and Public Policy*, 3rd Ed., St. Martins, New York.

Jones, Carol [this issue]

Kolstad, Charles D. (2000). *Environmental Economics*, Oxford University Press, New York.

Leeworthy, Vernon R, Norman F. Meade, Kathleen Drazel and Daniel S. Schruefer (Sept. 1989). "A Socioeconomic Profile of Recreationists at Public Outdoor

Recreation Sites in Coastal Areas: Volume 2," National Oceanic and Atmospheric Administration Report, Washington, DC.

Leeworthy, Vernon R, Daniel S. Schruefer and Peter C. Wiley (April 1991). "A Socioeconomic Profile of Recreationists at Public Outdoor Recreation Sites in Coastal Areas: Volume 6," National Oceanic and Atmospheric Administration Report, Washington, DC.

Leeworthy, Vernon R. and Peter C. Wiley (Nov. 1991). "Recreational Use Value for Island Beach State Park," National Oceanic and Atmospheric Administration Report.

Leeworthy, Vernon R. and Peter C. Wiley (March 1993). "Recreational Use Value for Three Southern California Beaches," National Oceanic and Atmospheric Administration Report.

Leeworthy, Vernon R. and Peter C. Wiley (March 1994). "Recreational Use Value for Clearwater Beach and Honeymoon Island State Park," National Oceanic and Atmospheric Administration Report.

McConnell, K.E. (1977). "Congestion and Willingness-to-pay: A Study of Beach Use," *Land Economics*, **53**:185-95.

McConnell, K.E. (1992). "On-Site Time in the Demand for Recreation," *Amer J Ag Econ*, **74**:918-25.

Mead, Walter J. and Philip E. Sorenson (Dec. 16-8, 1970). "The Economic Cost of the Santa Barbara Oil Spill," pp 183-226 in *Proc.*, Santa Barbara Oil Symposium, University of California, Santa Barbara.

Moncur, James E. T. (1975). "Estimating the Value of Alternative Outdoor Recreation Facilities within a Small Area," *J. Leisure Research*, **7**:301-11.

Ruud, Paul (December 4, 1994). "Beach Attendance in the Vicinity of the American Trader Oil Spill," Report submitted to the State of California Attorney General's Office.

Shogren, Jason F., S. Y. Shin, D.J. Hayes, and J.B. Kliebenstein (1994). "Resolving Willingness to Pay and Willingness to Accept," *Amer Econ Rev*, **84**:255-70.

Silberman, Jonathan and Mark Klock (1988). "The Recreation Benefits of Beach Renourishment," *Ocean and Shoreline Mangement*, **11**:73-80.

Smith, V Kerry and Raymond B. Palmquist (1994). "Temporal Substitution And The Recreational Value Of Coastal Amenities," *Rev Econ Stat*, **76**:119-126.

Sullivan, Arthur M. (1991). *Urban Economics*, Irwin, Homewood, Illinois.

US Army Corps of Engineers (1981). "Beach Erosion Control and Hurricane Protection Study for Dade County North of Haulover Beach Park, Florida," Appendix 4, Survey Report and EIS Supplement.

US Army Corps of Engineers (Dec. 1993, Revised June 1994). "Martin County, Florida, Shore Protection Project, General Design Memorandum", Jacksonville District, South Atlantic Division.

Table 1: Reported Attendance vs. Attendance Estimated from Aerial Photographs

Beach	Date	Mean visit duration	Maximum number of visitors	Reported visits	Estimated visits	Estimated /reported visits
Huntington City	17 Feb 95 (Fri.)	1.91	700	6,242	2,676	0.43
Huntington City	18 Feb 95 (Sat.)	2.73	3938	22,132	9,631	0.44
Newport	17 Feb 95 (Fri.)	1.75	1091	14,000	4,225	0.30
Newport	18 Feb 95 (Sat.)	2.59	5911	75,000	15,529	0.21

Notes:

1. Maximum quantity of people on the beach at any one time is assumed to be the number of people counted on the 1:30 p.m. aerial photo. Mean visit duration is in hours.

2. Estimated attendance is computed using aerial photographs and surveys of visit duration, as described in the text.

3. Sample size for computing duration: Huntington City, 74 (Feb 17) and 131 (Feb 18); Newport Beach, 107 (Feb 17) and 117 (Feb 18).

4. The weekend of Feb. 18 was a holiday (President's Day) and the weather was warm and sunny.

Table 2: Summary of Identified Saltwater Beach Valuation Studies

Description [Including state and date of data]	Original Value ($ per beach-day)	Value in 1990 $
CONTINGENT VALUATION ESTIMATES:		
Bell and Leeworthy (1986) CV Approach [3/1984, Florida]		
Mean	$1.31	$1.63
Median	$0.33	$0.41
Marginal	$0.77	$0.96
Binkley and Hanemann (1978) [12/1974, Mass.]		
WTP1 (Mean, Median)	$1.98, $1.08	$4.88, $2.66
WTP2 (Mean, Median)	$2.08, $1.24	$5.13, $3.06
WTP3 (Mean, Median)	$2.03, $1.24	$5.01, $3.06
McConnell (1977) [8/1974, Rhode Island]		
at 60^{o} F	$0.37	$0.95
at 70^{o} F	$0.78	$2.00
at 80^{o} F	$1.68	$4.30
NOAA (Leeworthy et al, 1989-94)--median [1988-90, Northeast, Florida, Pacific Coast]		
Cabrillo-Long Beach/Santa Monica	$1.12-1.89	$1.16-1.95
Other Southern California beaches	$1.00-5.22	$1.03-5.39
Florida	$1.85-2.38	$1.91-2.46
All U.S.	$2.09-4.31	$2.16-4.45
TRAVEL COST ESTIMATES:		
Bell and Leeworthy (1986) Travel Expenditures [9/1983, Fla.]		
Average	$10.23	$13.00
Marginal	$1.08	$1.37
Moncur (1975) [8/1972, Hawaii]	$0.35-$1.37	$1.07-$4.18
Bockstael, McConnell and Strand (1988) [1984, Mass.]		
Range, six beaches	$1.24-10.19	$1.53-12.55
Mean, six beaches	$3.23	$3.98
McConnell (1992) [11/1984, Massachusetts]	$0.58-0.94	$0.70-1.14

Note: Certain studies identified were excluded from our review and from this table due to limitations with the data or methodology used. These are: Dornbusch & Co. (1982), U.S. Army Corps of Engineers (1981, 1993), Curtis and Shows (1982), and Silberman and Klock (1985).

ENDNOTES

[*] Department of Economics, University of California, Santa Barbara 93106. The authors were experts for one of several defendants in the *American Trader* oil spill litigation. However, as far as we are aware, all litigation in this case is complete and the case has been settled. Our own involvement ended in 1996. Nevertheless, we should point out that the opinions expressed here are our own. Comments from three anonymous referees and the issue editor, John Braden, are acknowledged and appreciated.

[1] See Chapman et al (1998) and Dunford (1999).

[2] See, for instance, Braden and Kolstad (1991), Freeman (1993) or Kolstad (2000).

[3] Using beaches outside of the accident area is not totally satisfactory since their attendance may be increased by beach closure at the study site.

[4] Dunford (1999) discusses this issue in the context of the Ruud's model.

[5] For instance, one can sample the population on the beach, asking such questions as "How did you arrive at the beach today?" with choices, car, walk, bicycle, city bus, other bus, other. For those who report arriving by car, one can ask whether they parked in an "official" parking lot or elsewhere, and how many persons were in the vehicle.

[6] Chapman et al (1998) report an alternate method which they applied to several beaches in Southern California, including Newport Beach and Huntington City Beach. They stationed monitors at a number of locations along the beach counting the number of people arriving. This would seem to be more accurate than lifeguard estimates though it is not clear how one deals with someone who doesn't stay on the beach during their entire trip but rather goes to the beach, takes a break to obtain lunch, returns, takes another break for a drink, etc.

[7] It may be unclear exactly what is included in reported attendance and what specific uses were precluded by the accident. In particular, which facilities (pier, water, sand, bikepath, parking area, playgrounds) were unavailable due to the accident and which are included in reported attendance? Conservative assumptions are one way of dealing with such ambiguity.

[8] One could distinguish between a twenty minute visit and a five hour visit in terms of value but that is not usually possible.

[9] This adjustment is discussed in Cox (1968).

[10] Note that the probability that i is sampled depends on the amount of time i actually spends on the beach and on the sampling rate during i's visit to the beach area. If i spent four hours in the beach area, with two hours in shops and restaurants, the probability of being sampled would depend only on time actually spent on the beach.

[11] If the visitor spends one hour of a four hour visit off the beach at a restaurant, then this probability must be adjusted by the fraction of time the visitor is on the beach: $(4-1)/4 = 0.75$. Basically, the longer the visitor is in the beach area, the greater the likelihood of being sampled; the more time spent in a restaurant, the smaller the likelihood of being sampled.

[12] Aerial photos were taken on three other days, though surveying was not done on those days. Using duration data reported in Table I, the discrepancy between actual and reported attendance shown in Figure 1 is evident in the three additional aerial photo days as well. The survey instrument used to generate the duration data may be found in Appendix A.

[13] More detailed discussion of empirical methods for valuing environmental goods may be found in Braden and Kolstad (1991), Freeman (1993) or Kolstad (2000).

[14] The dollar value individuals assign to time spent traveling in vehicles has been studied intensively. Economic evaluation of new rapid transit systems has motivated much of this work, as reduction in travel time is the main benefit of such systems. This extensive literature has been reviewed by others and broad generalizations on the value of time spent traveling have emerged. Heilbrun (1993) concludes that "individuals value travel time at not more than half their wage rate." Sullivan (1991) generalizes from empirical studies of urban transit that "commuters value time spent in the transit vehicle at about one third to one half the wage."

[15] Smith and Palmquist (1994) is one of the few papers we know of that deals with temporal substitution.

[16] For example, McConnell (1977) looks at the effect of crowding and temperature on the value of a Rhode Island beach visit. Binkley and Hanemann (1978) look at the effect of water quality improvements on the value of beach recreation in Boston.

[17] The survey presented here is current, to the best of our knowledge, through mid-1996.

[18]We are excluding a study done by Mead and Sorenson (1970). Their approach to measuring the value of a beach-day of recreation is considerably more problematic than all of the CV studies reviewed here.

[19]See "Natural Resource Damage Assessments Under the Oil Pollution Act of 1990," Federal Register, 58 (10): 4601-14 (January 15, 1993).

[20] See 61 Fed Reg 440 (January 5, 1996) codified at 15 CFR. See also Jones (2000).
section 990.

[21]For example, see Shogren, et al (1994).

[22] McConnell (1977).

[23]It is unclear if visits to the beach are visits to all beaches or visits to the beach where the interview took place.

[24] Binkley and Hanemann (1978).

[25]Question 7, part E, PARVS survey form dated June 1990.

[26]Leeworthy and Wiley (1991, 1993, 1994).

[27]To see the problem, suppose there are 10 such persons and each normally makes a visit every 10 years. If they were interviewed over a 10 year period, each of the 10 would report a visitation rate of 0.1 per year. It appears that the NOAA study would record one visit per year for one person in this instance. This is not equivalent to measuring the visitation rate correctly, and it will not yield accurate data on the relationship between travel cost and visitation rates.

[28]The household's consumer surplus per trip is given by their equation (4.11) divided by the number of trips. The expected household consumer surplus per trip is approximately equal to the average number of trips divided by twice the absolute value of the coefficient on price (access cost) in the demand equation.

[29]The NOAA survey for Pt. Lookout Beach in Maryland shows an average group size of 3.78 (Leeworthy et al,1989). Pt. Lookout is one of the beaches in the Bockstael et al study.